THE

ELECTRICAL REVIEW.

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ELECTRICAL REVIEW.

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THE

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THE GAS ENGINE IN AMERICA.

SEEING that America has been blessed with a supply of natural gas of high thermal value, which only required to be tapped and applied to useful purposes, an operation not involving a heavy first cost, it is somewhat surprising that the application of this store of fuel to power purposes, by means of internal combustion engines, has not brought about the development of the gas engine in America in advance of those countries not having equal advantages. A study of certain organs of the engineering Press during the last few years would lead one to suppose that the Americans were leading in all matters where ingenuity and technical applications were concerned; but the advance in gas engine design, through the utilisation of blast furnace gas and producer gas in England, Belgium, Germany, &c., has led us to wonder how it is that America has not taken fuller advantage of the economy to be gained by the adoption and perfecting of the internal combustion engine. That gas engines of considerable power have nevertheless been made in the States is well known, the Westinghouse Co.'s vertical gas engine, and the Snow Plough Co.'s engines, having been described and illustrated in the engineering papers.

Our contemporary, the *American Electrician* for February, has an article on the "American 'Crossley' Gas Engine," as adopted by the Power and Mining Machinery Co., of New York. Now, it will be evident that at this date, in choosing a type, such an important company would make a thorough examination of all the different designs of gas engines now being exploited in Great Britain and on the Continent, before coming to a decision, and it speaks well well for the Old Country that the American company has adopted the "Crossley" pattern.

In our issue of August 14th, 1903, we illustrated the different types of gas engines made by the Crossley Co., so that it is only necessary to refer to the principal characteristics of the engine adopted by the Power and Mining Machinery Co. The cycle of these engines is the "Otto four-cycle," in preference to the "two-cycle" engines of the "Körting" and "Oechelhäuser" class, and the engine illustrated in our contemporary is of the *vis-à-vis* arrangement of 650 H.P. To procure a minimum of cyclic irregularity with this arrangement of two four-cycle cylinders, the fly-wheel rim has to be of considerable weight, owing to there being two impulses immediately following each other in one revolution, and then two strokes without impulse in the following revolution. Another feature of the latest type of Crossley engine is, that the method of governing is that which regulates the explosive mixture to suit the load, down to that point at which the charge becomes so weak as to be uncertain of ignition, when the governor automatically brings into action the hit-or-miss arrangement; the governor, moreover, is driven from an independent shaft actuated by the spiral gear, which also drives the side shaft. This method of using an independent shaft relieves the governor from the jarring effect of the stress on the side shaft due to the actuation of the exhaust valve and other valves. Indicator diagrams taken from an engine fitted with this class of

governor show very satisfactory reduction of the force of the impulse to suit the load, with economy of gas.

Good features of the four-cycle engine are simplicity, small number of parts, and general get-at-ableness for cleaning and overhauling. When a firm in this country brings skill and workmanship into full play, it is able to compete with the U.S.A., or any other country, and hold its own.

The Public Authorities' Protection Act.

A CASE of considerable importance to local authorities who indulge in municipal trading, was decided by Mr. Justice Channell on February 21st. An action was brought against the London County Council by a person who had sustained injury in a tramway accident. The defendants contended that in carrying on the working of the tramcars they were protected by the provisions of the Public Authorities' Protection Act, 1903, and that inasmuch as the plaintiff had not commenced proceedings within six months of the negligent act complained of, the action was barred by the limitation provided by Sec 1 (*a*) of that statute. This came before the Court as a preliminary point. After a lengthy legal argument, Mr. Justice Channell decided in favour of the County Council. In the course of his judgment he said :—

"The complaint against the defendants is one of negligence in working the trams. If the matter had been open to me, I should have been inclined to say that on the true construction of the section, the defendants would have been protected from the consequences of negligence in the course of the construction of the tramways, but that they would not be protected from the consequences of their servants' negligence in carrying on the work in relation to the working of the trams after the construction was completed. The case, however, was covered by the authorities, and, in particular, by the case of 'the Ydun.' This decision may be expressed in a few words to be that the plaintiff, in a running-down case, who is suing a local authority, is subject to the disabilities of the Public Authorities' Protection Act. Let us see what this involves. The material parts of the Act provides that 'any action, prosecution or other proceeding commenced in the United Kingdom against any person for any act done in pursuance, or execution or intended execution of any Act of Parliament, or of any public duty or authority, or in respect of any alleged neglect or default in the execution of any such Act, duty or authority, shall be brought within six months as therein provided, and that the defendant, if successful, shall have the costs as between solicitor and client. The Act does not apply to proceedings arising under an Act which applies to Scotland only, and contains a limitation of the time and other conditions for the proceedings. It will be seen at once that the Act does not excuse the local authority from liability; it merely prevents it being sued, unless the action is brought within a certain time. It has been held not to extend to proceedings against a company with statutory powers, which exists not only for the public benefit, but also for the purpose of earning profits, if it can. It will also extend to proceedings against a local authority in respect of a trade or business carried on by it by virtue of statutory powers." The principle laid down by Sir Francis Jeune has now been affirmed by the Court of Appeal. As we have often stated on former occasions, the partial immunity afforded to a local authority by this Act gives these bodies an advantage over private companies whose hunting grounds have been encroached upon by the devotees of municipal trading. So long as a local authority is performing a strictly public duty, we see no objection to it being protected from vexatious litigation. It is otherwise when it undertakes work which can just as well be performed by a private concern.

Trans-Atlantic Engineering Schools and their Lessons.

IN our issue for October 9th last we gave some account of the preliminary report drawn up by Dr. R. Mullineux Walmsley upon trans-Atlantic engineering education. It will be remembered that Dr. Walmsley, who is Principal of the Northampton Institute, in Clerkenwell, took a three months' tour through the United States during last year—not in the holiday season, but when the colleges were in full work—in order to study American methods on the spot, and to report to his governing body as to the suitability or otherwise of copying them here. His first report was for the authorities of his Institute, the second is a bulky "paper" of some 50 pages communicated to the Institution of Electrical Engineers on February 11th last.

The main portion of the present document consists of a detailed description of the methods adopted in the numerous establishments visited, of a discussion of the characteristics exhibited by the students turned out, and of the attitude of American employers in general to those students, while, at the end, Dr. Walmsley devotes a few pages to a summary of his impressions and to a recapitulation of the lessons which are worth learning in the United Kingdom. Running through the whole pamphlet to an extent which renders it the *leit motif* of the piece, is the statement that no premium is required when trained engineering students enter American works. In our country, pupils who offer premiums are seldom refused, even if their training has been insufficient; and, when they are accepted, they are often simply allowed the run of the factory on the off-chance that they may pick up knowledge and experience. In the States, employers ask no premium, but pay a living wage, because they consider it advantageous to do so. Even if our manufacturers were prepared to take students on the same relative scale as is done in America, our schools are neither staffed nor equipped to produce a large enough number of trained men. But, on the other hand, some of our students who have been trained well may be found in the States holding their own perfectly. Moreover, to a large extent owing to the "incubus" of the premium system, British parents will not find the money for a proper college education, but listen to the arguments about so-called "practical" training, and prefer to enter their sons at once into works. "To sum up, it is the employers and manufacturers who hold the key of the position, and it is for them to say whether the leeway" in British engineering educational methods "is to be made up in this generation, or postponed until it is too late."

Mr. Walmsley, however, does not content himself with destructive criticism, but essays the more difficult, though vastly more profitable, task of construction. He agrees that our system of secondary education is lamentably deficient, because the future engineer is compelled to worship the humanities to the practical exclusion of science. This must be put right; but we cannot afford to wait till that is done, or the present generation of schoolboys will be left out in the cold. It is therefore necessary for the technical colleges to make the best of the material sent them; and some of it is not bad. Mr. Walmsley desires a four years' college course, with the last two "long summers" spent in works, the whole followed by, say, another solid year in the factory. This plan allows the students who have mistakenly gone in for engineering of any kind to be weeded out in the colleges, and so protects the works from them. Under the various Acts of Parliament some million of money is spent every year in England and Wales upon technical education, but only a little of it has been devoted to higher engineering education. A similar remark applies to the money spent by the Board of Education. More of our existing monetary resources ought to be spent upon engineering. Within the past few years certain scholarships have been earmarked for commercial education; engineering should be treated identically. Surely the great productive industry of engineering is as worthy of attention in this respect as the distributive industry of commerce. Last June there were 179 intermediate London County scholars in attendance, and only 25 were taking engineering classes, yet all were drawn from the class which might be expected to feed the productive rather than the distributive branch of trade.

The position attained by engineering education in the United States and Canada is due to very recent expansion; it is not altogether the work of the past 10 years, but the greater part is, especially that portion which has caused the complete revolution in the attitude of the American employer towards the colleges. Ten years' lost time is not too much for us to make up, but further delay renders the task more difficult; and if we neglect our duty much longer, it may become well nigh hopeless for us to regain the position as an engineering nation which we are allowing to escape into others' hands.

THE OPERATION OF RAILWAY POINTS AND SIGNALS BY POWER.

By a Railway Official.

The installation of the "Crewe" system of power signalling on the North-Eastern Railway, at York, is one of the latest of a number of experiments in various parts of the country, in the substitution of power for manual labour in the operation of points and signals. For many years railway signalling apparatus has been of a stereotyped character, but present practice shows considerable indications of change. Not only has the apparatus for the operation of the points and signals been unchanged for a considerable period, but that other important adjunct to railway signalling, the electrical block apparatus, has, except for comparatively small installations of the lock and block systems, undergone practically no change during the last quarter of a century. In this branch of the subject, however, there are signs of some degree of change. Perhaps, in consequence of recent visits to the United States, American systems of automatic signalling are being experimented with, to some extent, most probably with a view to ascertain their suitability or otherwise for the somewhat different conditions obtaining in this country. The changes here outlined do not affect the signalling from the engine-driver's point of view, but there are not wanting those who advocate radical changes in this direction also. Amongst the latter are those who desire to see introduced systems of signalling directly upon the engine, either as an auxiliary to meet certain well-known conditions, or as a complete substitution of the present method of signalling; and suggestions are also made in some quarters which, if adopted, would dispense with the ordinary signal arms altogether and rely upon lights for both day and night signalling. In this case, two lamps, showing red and green respectively, would be provided, and would be operated in accordance with the conditions existing from time to time. In such a system electric lighting would be a necessity in order to effect any material change in the method of operation and the corresponding reduction in first cost, which it is hoped the introduction of the system would effect. The use of such a system would, therefore, be limited to places where an electrical supply can be readily obtained. Whether the ultimate result would be economical is a doubtful point, and the effectiveness of such a method of signalling to drivers of trains under all conditions is also extremely doubtful. Leaving these suggestions, which probably have their origin in a desire to reduce expenses, on one side, it may be of interest to consider the question of the operation of points and signals by power, as opposed to the manual operation which, in this country, up to a quite recent date, has been invariably used.

To commercial men a new system of working, appeals only in so far as it can be shown that it will favourably affect their businesses. If it is directly economical, by reason of lower first cost or economy of labour, good. If it is equally directly economical by facilitating dispatch of business and enabling more to be handled, it is also good. If it is less directly of advantage in that it tends to safety of operation and freedom from accident, and consequent delay, it is still good, but not to the same degree as when it directly and favourably affects the returns on their investments. The most ingenious engineering combinations, or applications of scientific laws, in no way appeal to the business man unless it can be shown that their use, as embodied in apparatus offered for his service, will result in a financial advantage. With the engineer or the scientific investigator the case is different. New combinations, or the discovery of new laws, appeal to them first on account of novelty, and excite admiration by ingenuity or simplicity of construction, or from the means by which discovery is made. The business man, however, is first and last concerned with estimates which search into all questions of application; and the business man is supreme. How do systems of points and signal operation by power affect results judged by these standards? Are they cheaper to install than the manually-operated systems? Are they more economical in use? Do they facilitate the disposal of traffic in any degree better than existing system? Do they, increase the safety of operation? And to each of these questions the final question is "How much?"

A glance through the arguments of those who advocate the use of power, discloses no claim of lower first cost for installation, and it is fair to presume that any material advantage in this direction is hardly likely to be omitted from the catalogue of advantages, since it not only affects the capital expenditure, but also the standing charges on that amount. On the question of labour cost for operation, the claims are more definite, since we are told that one man can do the work of three, in a cabin equipped for power signalling. At the same time, we are told that, in consequence of the diminution of physical labour, the signalman is left more at liberty to direct attention to train movements; and it is also stated that dividing the work of a large cabin amongst a number of men, divides the responsibility more or less, and has frequently resulted in mistakes. These statements seem hardly consistent. If more leisure is necessary for the signalman to allow of his noting more carefully the movement of trains and the positions of his points and signals, why attempt to impose upon him the duty of three men, and so deprive him of the leisure he should have? If, however, divided operation tends to mistakes, and the system allows of the physical labour of one man being made equal to that of three men with the ordinary system, in what respect does the signalman obtain the advantages for more accurate observation which are claimed? In any case, what else but train movements is it that directs his operations with the points and signals, especially in those places where power-signalling systems have hitherto been chiefly installed—busy junctions or shunting points? Must not the signalman be acquainted with the positions and requirements of trains before he can satisfy the latter, and do not the positions of his levers tell him what are the positions of the points and signals? Is not the interlocking intended to prevent mistakes in the operation of points and signals, and does it not control absolutely all signalling operations? Even in power systems, the mechanical interlocking of the levers is the first and most important check upon operations, and other devices or checks are, in the majority of instances, intended to provide for cases arising from possible discontinuity between the movement of the lever, and the object ultimately operated. Is it not the case, when two or three signalmen are engaged in one cabin, that the necessity arises more on account of the need for speed in operating rather than for any other reason, and that such speed is impossible in large cabins with one man only, on account of the distances between the levers? When two men are making a combined operation in a cabin the movements must be made in a predetermined course, prescribed by the interlocking and the preceding positions of the points and signals, and one man must wait until the other has made all or part of his movements before he can commence. The speed so obtained is solely due to the absence of the necessity for travelling to and from the various levers, as would be necessary if the operations were all made by one man. It is therefore rather the relative positions of the levers to be operated, the distances between them, and the order of operation that necessitate the employment of a number of signalmen in a large cabin to complete operations in a reasonable time, than any other circumstance.

On the score of facility in the disposal of traffic it is common knowledge that a well laid out yard is the most effective factor. Facilities for getting quit of traffic depend more upon the room for shunting, and the relative positions of the lines, than any other circumstance. A signalman can but allow of the occupation of the lines in accordance with his signalling arrangements, his rules for working, and such information as is afforded to him by traffic directors of the relative importance of the trains to be dealt with. The signalman is more a guardian against improper combinations of traffic on the portion of line under his care, and, especially at large shunting points, he must work to the requirements of those who are directors of traffic movements.

An important point in connection with the facilitation of traffic is the time in which a signalman can make the various movements for a complete operation. With the ordinary manually operated frame each individual movement is completed at once. With power systems, generally speaking, the operation of points is not completed by one

movement of the lever controlling them. The actual movement of the points does not directly follow the motion of the lever, but is effected through another medium which must complete its work before the lever movement which called it into operation can be completed and release the appropriate successive levers. This necessitates pauses in the movements of the point levers, corresponding to the times occupied in the actual movements of the points by the motor, &c., and the receipt of the check indication which, whilst comparatively small individually, are cumulative for a number, and tend to increase the time required for a complete operation. Such pauses are necessary, of course, so that independent intimation of the complete movement of the points in the direction desired may be obtained, before freeing levers operating signals controlling the movement of traffic over the points in question. To those accustomed to the direct operation of the points with the levers, these pauses and the necessary wait for the intimation of the completion of the points movement are curious, and it would appear that they must materially affect the time necessary for a complete operation where a considerable number of points have to be moved.

The last point to be considered is the question of safety of operation, and how far it is affected by power signalling. Generally speaking, it may be said to be but little affected either way. The chief check on inadvertent action on the part of the signalman is still the mechanical interlocking between the points and signal levers required by the Board of Trade; signals still return to the "off" position by gravity on the removal of the restraining force, and points are mechanically locked in either position. Hence failure of apparatus in part or wholly, tends to delay rather than to danger from conflicting movements of traffic, which, of course, is the condition that should obtain under such circumstances. Unauthorised movements of traffic, however, are without any additional check and signals may be passed at "danger" or points run through in the trailing direction without warning being given to the driver or signalman.

From what has been said, it is apparent that power systems for the operation of points and signals are principally of value in that they diminish the physical labour of the signalman. If it is assumed that the labour hitherto entailed has not been excessive, and may still be imposed, then the introduction of a power system may be economical by reducing the number of men required, or, on the other hand, by allowing of an increase of the area to be controlled. As has been already seen, there are other conditions which have considerable effect in determining the number of men to be employed; and there are very narrow limits to the distance over which a signalman can exercise effective control at busy places. The annual cost of power, especially in cases where a special installation is necessary, cannot fail to be considerable, and will go a long way towards wiping out any advantage obtained by a reduction of the number of signalmen employed. Isolated installations, with their own power plant, can hardly be expected, in any case, to compare favourably on the score of cost, with the ordinary system. Only when applied to a number of cabins extending over a considerable distance can such installations be considered as operating under conditions favourable to economy; but it by no means follows that successive cabins from a junction or shunting-yard, where a power system would be appropriate, are also of the same character. In quite the majority of cases, such cabins would be small, and whilst a signalman would be necessary to control the working of the traffic, the amount of physical labour to which he would be subject would not be excessive, and would not, on this score, justify the replacement of manual labour by power.

For the reasons given, any large extension of the use of power for signalling purposes is not likely to be experienced under the present conditions of railway operation in this country. The installations now in use may be looked upon as experiments only, which, even if they were a financial success in each case, are not of sufficient magnitude, or likely to be, to affect the working of the several lines upon which they have been installed. That signalling in this country is costly, and its advantages indirect, may be admitted at once, but there is no immediate prospect of a system that will replace it altogether. The directions in which railway companies will require to make radical changes, in order to consolidate their positions, are of quite a different character, and every year's delay in setting their houses in order will render them less able to meet the increase in competition which is inevitable in the near future. Competitors with newer methods of transport, more modern ideas of their duties to their clients, and the methods for more effectively carrying out those duties, and unencumbered by loads of long-dead capital, cannot fail to render the tenure of steam railways insecure, and tend to a repetition of the same mad rush to repair years of neglect which is characteristic of the present time.

THE HIRE-PURCHASE OF MOTORS.

In our issue of the 19th ult. a brief *résumé* of Mr. Britton's paper read before the Glasgow Local Section was given, and we commented on some of the views expressed by the author. From the report of the discussion which has since come to hand, it appears that the fight raged almost entirely round municipal trading, despite the Motherwell engineer's attempts to keep this in the background. It is, of course, natural that the contractors should oppose Mr. Britton's suggestion, and that they should, as traders, be anti-municipalists; though it is a little surprising that manufacturers should take up the same attitude, except on the purely personal ground that they have not been sufficiently successful in securing Corporation orders for motors. But every Corporation engineer should be allowed to purchase motors in the cheapest market, consistent with his getting a good article, in the interests of his undertaking and of his consumer. This is, of course, on the premise that municipal trading should be allowed. Mr. Sam Mavor does not think so, nor does Mr. H. A. Mavor; and as for the chairman, Mr. J. M. M. Munro, he made a long and vehement tirade against the whole thing, ending up by stating that he did not wish to be considered an opponent of municipal enterprise. The gist of these gentlemen's remarks was that corporations should not be allowed to trade in anything except what is for the public benefit, and that as for motor hire-purchase, this should be left to private enterprise. With regard to the first objection, it has been argued that a man who does well for himself does well for the nation, and that the idea that the consumer has no right to benefit at the expense of other classes of the community is absurd, for he will by increased prosperity employ more labour and turn out goods more cheaply than before. Again, humanity is not yet so perfect that private enterprise can be made to order, and people are not always inclined, *for the benefit of the community*, to risk their money in hire-purchase schemes, especially when a mere 3½ or 4 per cent. is the only dividend in view. On the other hand, if corporations can efficiently (we use the term advisedly) carry on such a business, it is certainly to the public benefit that electricity should become cheaper by this means, and also that money should be kept in circulation. By all means let private enterprise be encouraged where it has taken root, but corporations are not likely to sit still and wait for the private enterprise which does not come, whilst their supply undertakings stand in need of every possible stimulus. But, as Mr. Parsons pointed out, they would, no doubt, be only too glad to be relieved of the responsibility by private people, and in this connection it was satisfactory to learn from Mr. W. W. Lackie that such a company had been started in Glasgow. This speaker remarked that, if private enterprise persisted in refusing to take up the matter, and there was a demand from consumers for motor hire on these terms, he did not see why a Corporation should not undertake it, however much it might be outside the ordinary limits of municipal trading.

One more interesting point was elucidated by Mr. Britton, who stated in his reply to a question asked by Mr. Ionides that in Motherwell they allowed 12½ per cent. per annum on the cost of the motor for depreciation, the hirer paying for all repairs. As regards motor hire only, which was hardly referred to at all, during their 2½ years' experience in Motherwell they had not spent more than £3 on the motors they had on hire.

Seeing that the paper is of interest both locally and also generally, it is a pity that matters of such importance are not also discussed before the Institution in London.

CORRESPONDENCE.

Letters received after first post on Wednesday morning cannot appear until the following week.

Workshop Practice.

The criticisms of Mr. Kilburn Scott on workshop practice are most amusing, and it is refreshing to find a prophet who can point out what *should* be done. A shaping machine with the stroke inwards, would be awkward to set, and Mr. Scott considers that the ram would be lighter when in tension. I always understood that cast-iron was much stronger in compression that in tension, but I think that Cotterill and Rankine must have been mistaken.

The *original* method of boring out alternator rings has been in use for some years; in some factories the ring is bolted to a star-shaped bed flat on the floor, and a long arm revolves on a fixed vertical shaft. It is a novelty to find that lathe bearings are not strong enough to stand the friction pull required to coil wire; I believe a stronger lathe would meet the case, automatic winding machines of the type indicated are in universal use for thin wires. Most firms dip the ends of armature bars previous to winding, and the use of the solder pot is not unknown in England; why not tip the armature and commutator into a Brobdignag solder pot and do them all at once? The existence of insulation is a mere detail.

Armature coil taping machines have been in use in England for some time, but they are only of use on special shapes of coils.

It is very sad to find that English factories do not make everything themselves, but nowadays specialisation is the cure, not multiplication; a small firm cannot make all its stampings at the price of a firm that delivers 10 or 12 tons a day, and as for other details, is it worth while to buy an expensive machine for the honour and glory of saving a few pence once a month? Many Continental factories use the system of making every little bit of a machine from an alternator casting to a lampholder, but the bankrupt condition of the average Continental firm speaks volumes for this practice. How are we going to get a decent surface on a steel casting, without filling and rubbing down; buyers sometimes like to have the machines decently finished, though there is nothing like spoiling the ship for a ha'porth of tar.

T. R.

Electricity in India.

"Your Correspondent," writing in your issue of January 29th, again returns to the subject of the Indian Electricity Act, 1903, and the rules thereunder. I send you, therefore, a copy of the *Gazette of India* containing the notification directing "that the said Act shall come into force on and with effect from January 1st, 1904," and promulgating rules thereunder. "Your Correspondent" no doubt saw the draft rules, which were published for information on September 15th, 1903, and he might have taken the trouble to check his statements before impugning my accuracy.

X. Y. Z.

February 17th, 1904.

Municipal Appointments.

This week a Corporation is advertising for an electrical assistant, and many of our profession will doubtless apply. I should have done so, but hearing privately, and on first rate authority, that the position was settled several weeks ago, I have deemed an application superflous.

I consider it a shame to waste men's time in applying—and what's more, in hoping—when the vacancy is already settled. Doubtless, those gentlemen with influence who can obtain positions without application will smile at this letter—but what of those who have not got that influence?

Ex-Applicant.

Development of our Industry.

Has any enterprising central station engineer ever tried to improve his long hour-load by offering inducements to private residents who are already consumers, to introduce the advantages of electric lighting among their acquaintances, and get them to adopt the light on the free wiring system. Such methods of expansion are widely used in other industries, and would seem to give good prospects in the field of electric lighting for similar reasons.

The inducement might take the form of allowing one quarter's electricity account to remain unpaid, provided two other consumers of similar capacity were induced to sign applications for supply. Certain regulations would be needed to prove claims definitely, and these could be readily arranged.

If successful, a great expansion of business might be expected. Will some enterprising engineers give their impressions on the subject.

Development Engineer.

Lessons of the Bristol Fire.

Although living in this far-off country, I still have the privilege of reading the Electrical Review every week, the only disadvantage being that each copy when received (out here) is about three weeks old.

During the last two or three weeks I have been much interested in some correspondence which has been going on in your columns with reference to the recent fire at the Bristol Electricity Works. In your issue of January 8th last there is a letter from Mr. E. Kilburn Scott, in which that gentleman is apparently pointing out to central station engineers a method for preventing breakdowns in electricity works.

In your issue of January 15th there are four letters in reply to Mr. Kilburn Scott's—one from Mr. A. Hugh Seabrook, engineer and manager of the Barking Electricity Works; one from Mr. Horace Boot, consulting and resident engineer to the Tunbridge Wells Electricity Works; one from "J. B. F."; and the last from Mr. E. Garside, of the Ferry Works, Thames Ditton.

I should like, in the first instance, if your space will permit, to make a few remarks with regard to Mr. Kilburn Scott's letter. In the first place, Mr. Scott compares an electricity undertaking with a gas undertaking. With regard to this, Mr. Scott makes the assertion that gasworks are, perhaps, better managed than electricity works. Is it possible that any right-thinking man can compare two such things? Mr. Scott goes on to say that breakdowns in electricity works do a tremendous amount of harm to the industry by giving the opposition something tangible to talk about; he also sets down Bristol as the ideal supply station in the United Kingdom. (If this is not Mr. Kilburn Scott's meaning, it certainly appears so from his letter.) He then further suggests that reserve plant—either in the shape of extra machinery or a storage battery—should be installed.

Can Mr. Kilburn Scott inform me of any electrical works in the United Kingdom, with the exception of those which are now, or have been recently, under course of construction, that are without the necessary spare plant?

He further goes on to say that the result of breakdowns similar to the one in question should be the means of flooding accumulator and electrical engineering firms with orders.

I am not personally acquainted with Mr. Scott, but, from a remark which Mr. Boot makes in his comments on this letter, I understand that Mr. Scott represented for some time a manufacturing firm of electrical engineers. If this is the case, Mr. Scott is no doubt writing this letter with a view to business.

To pass on to your next issue, although I cannot agree with Mr. Scott's remarks, I think there are one of two paragraphs in the letters of reply which are mentioned, which are worthy of criticism.

Mr. A. Hugh Seabrook, in commenting on this letter, asks for particulars with regard to a battery which would take the load of a station such as Bristol for 24 hours. Mr. Seabrook further goes on to ask what would be the capital cost of upkeep, including transforming gear, &c., losses of efficiency between a steam alternator and the distributing mains, the annual depreciation, interest and sinking fund.

I may be an amateur in the way of electrical engineering, but I fail to see how a storage battery can be used as a stand-by on an alternating-current system.

To pass on to Mr. Horace Boot's letter. While fully recognising the responsibility of a central station engineer, I do not think it is good form for any engineer to personally blow his own trumpet, as Mr. Boot does in his letter. We are all fully aware of the necessary qualifications of a central station engineer, but in the letter in question, we are practically told that all central station engineers must be, not only perfect electricians, but also first class marine engineers. I should like to give you an instance of a remark which was made by a well-known chief engineer in an English central station to an assistant in a corporation electricity works with which I was connected some years ago. The chief engineer in question was looking round the station and happened to catch sight of the vacuum gauge belonging to the condenser; the gauge, at the time, was registering 27½ in. of vacuum. This enlightened gentleman made the remark to the assistant in question that he considered 27½ in. a very poor working standard, since, in his station, whenever the condenser was working they always ran with 32 in. of vacuum. It appears to me, under these circumstances, that the said chief engineer must have entirely broken down the rules of nature.

While fully recognising the responsibilities which have to be taken by a central station engineer, it strikes me that Mr. Boot's remarks with reference to Mr. Scott's letter are somewhat strong.

Passing to the next letter of "J. B. F.," Mr. Kilburn Scott is asked whether he knows of any central station possessing a battery that will supply the maximum, or even half the maximum load.

I will not mention any names at present, but I think I can give the name of one station, which, although not a public station, is at the same time considerably bigger than many public stations in England, which can supply its full load for, say, 12 hours. With regard to the last paragraph in this letter, I quite agree with "J. B. F." that the majority of cases of total breakdowns, the consequence of which is that the total supply is unable to be maintained, are due to committees, and not to the chief engineers.

With regard to the last letter of Mr. E. Garside, I entirely agree with him that high-tension switchboards are very much better without fuses. If this is to be the case, my opinion is that there is only one absolutely satisfactory system to go upon, and that is Andrews's patent return current cut-out system, which entirely does away with fuses on the machine panels of the switchboard. Although this system means laying duplicate feeders, and will not absolutely prevent the lights being out owing to a breakdown of the machinery in the central station, I think I am perfectly correct in saying that it will, in nine cases out of ten, prevent the total extinction of the lights as a result of a breakdown on the mains.

Colonial Electrical Engineer.

Cape Town, S.A.,
February 10*th*, 1904.

[We are always glad to hear from our Colonial friends, and regret that we cannot at present transmit the ELECTRICAL REVIEW to the Cape in less than three weeks. We have Good Hopes for improvement in the future, when the express airship is an accomplished fact.

We may point out that, so far as we know, Mr. E. K. Scott is not connected with a manufacturing firm. Also that a storage battery can be used as a stand-by on an A.C. system in conjunction with a motor-alternator, by which the low-pressure direct-current is converted to high-pressure alternating current; this system has been actually applied in some cases.—EDS. E.R.]

Gas v. Electricity.

In reply to "Agnostic," who, in your issue of the 26th ult., desires to know the quantity of gas consumed by various types of burners, I beg to submit the results of some experiments which I recently carried out, and which I trust may be of use to your correspondent.

The comparisons were made by means of a Methven gas standard and a Joly photometer, and the following are the mean values obtained :—

Burner.	Cb ft. gas consumed per C P. hr. at pressure giving highest efficiency.	Cost per C.P.-hour, with gas at 8s. per 1000 cb. ft.
Brays' No. 6	·34	·0122d.
Suggs' No. 5	·32	·0115d.
Brays' No. 8 enamel regulator,	·28	·0100d.
Incandescent	·05	·0018d.

Taking an average electric glow lamp consuming, say, four watts per candle-power, and energy at 6d. per unit, the cost per candle-power-hour for electric lighting is ·024d., from which it is apparent that, under average circumstances, and on a basis of "so much light for so much money," gas is the cheaper form of illumination.

However, against this cheapness must be balanced the fact that in the case of gas illumination, over 99 per cent. of the total energy is manifested in the form of heat, and that air is consumed and carbon dioxide evolved. In an average electric glow lamp only about 92 per cent. of the total energy is manifested in the form of heat; no air is consumed or gas evolved; therefore, apart from the considerations of healthiness and convenience, it may be concluded that in cases where the illumination is in proximity with valuable furniture or pictures, electric light, although apparently more expensive, would, by lessening depreciation, balance with the cost of gas.

H. Waymouth Prance, A.I.E.E.

London, W.,
March 1*st*, 1904.

[As we have often pointed out, the bare cost per candle-power-hour under test is only one of the factors entering into the comparison. It is true that 1 oz. of margarine costs less than 1 oz. of butter; but is that a sufficient reason for preferring margarine?—EDS. E.R.]

Small Gas Engines v. Electric Motors.

Referring to Mr. Mensforth's letter on this subject in your issue of the 4th inst., it will be seen that he estimates the gas consumption of a 14 B.H P. engine at no load as 88 cb. ft. per hour. This appears unnecessarily hard on the engine. In the report of the Society of Arts' trials which took place as long ago as 1889, it was found that a gas engine of 14·74 B.H.P. consumed 52 cb. ft. per hour on no load. An engine of 9·5 B.H.P., recently tested by the writer with the belt off, took only 27·7 cb. ft. per hour.

The cost of the oil is too small to materially affect the question, but the cost and quantity are as stated by the user after reference to his books. No doubt he has to use a large quantity of such inferior oil.

The instance of the 8-B.H.P. gas engine, given by Mr. Mensforth, seems perfectly fair, but this engine is running on a much better load factor and with lower-priced gas than in the other case. The writer recently went into the case of a 33-B.H.P. engine working continuously for 50 hours a week, at half load, with gas at 2s. 9d. per 1,000, and the cost per B.H.P.-hour came out to 1·33d. It is not claimed that a motor is cheaper in every case, but that there are a great many cases of intermittent load in which it would be so.

To obtain the greatest benefits in such cases, it is usually necessary to provide separate motors for the principal tools.

Referring again to Mr. Mensforth's example, and accepting his figures, if interest and depreciation are taken into account, the engine would not have the best of it.

An 8-B.H.P. gas engine, delivered and erected with foundations and accessories, would not cost less than £75. On this take 5 per cent. interest and 5 per cent. depreciation = £1 17s. 6d.

A 6-B H.P. motor, delivered and erected, should not cost over £27. On this take 5 per cent. interest and 3 per cent. depreciation = 9s. 3d.

Then we have the total costs per quarter :—

For the gas engine ...	...	£15	0 0
„ motor	...	£14	17 3

With regard to Mr. Hibbard's letter, no doubt such figures as he gives have been obtained. They are not,

however, the figures usually obtained for engines of miscellaneous makes after several years' use; and the original article was on the subject of replacing existing gas engines.

The Writer of the Article.

March 7th, 1904.

Your correspondent Mr. Hibbard, in his letter on the above subject, gives us figures of such a startling nature, that I hope you will permit me to ask him to furnish myself, amongst others of your readers, with the following further information.

What is the calorific value of the gas used, where they are working on 15 cb. ft. per B.H.P.-hour? At how many places can one get lighting gas at 1s. 3d. per thousand, these hard times? And, where is the small gas-driven electric plant which *is* giving a Board of Trade unit for one-seventh of a penny? (You will notice I ask *is*, not *can*.)

May I point out that a consumption of 15 cb. ft. of gas per B.H.P., gas of 600-B.Th. units per cb. ft., mech. eff. of engine 85 per cent., gives a thermal efficiency of 33·2 per cent. about, to I.H.P. Is this a regular commercial figure?

H. Mensforth.

March 7th, 1904.

I have read with interest the article "Small Gas Engines *v.* Electric Motors" in this week's Electrical Review, and quite agree with the first few lines. If the writer of the article is unable to make out a better case for electrical driving than the example he gives, I fear his efforts to displace that 600 H.P. of gas engines will meet with little success.

By a strange calculation he discovers that the engine is working at just half load for 209 hours per quarter, and could be shut down for the odd 415 hours. One can scarcely take such a statement as this seriously.

Is it not possible that some small machine, taking, say, 1 H.P., is running nearly all day? If so, then the motor, *when* installed, must run for a considerable period much underloaded, as the gas engine at present probably does.

It has not been my good fortune to know of any works (assuming it employs more than one machine) where the work can be so arranged that it requires a uniform power for a certain time, and can then be finished at one instant.

Finally, there is a paragraph near the end of the article that I must take exception to. It refers to "interest and depreciation," and I can only ask the writer to read an article in the Electrical Review of August 28th, 1903, in which an engineer writes in a very able manner of the effect of interest and depreciation on proposed substitution of new plant for old.

E. A. L.

I noticed in your issue of February 26th an article, evidently communicated by a correspondent, and bearing the above title. Can you kindly spare me room in your paper for the following criticism from one interested in the use of gas engines?

1. Amongst the figures used in his calculations the writer of the article shows that only one is ascertained from actual practice—viz., the quarterly gas bill for the engine. Every other figure is theoretical. His conclusions are therefore only hypothetical.

2. He does not pretend to know the actual gas consumption of the engine per B.H.P., nor the consumption running light; yet on these data absolutely depends the accuracy of his comparison.

3. Again, he admits that the engine runs for 48 hours per week, or 624 hours per quarter—in other words, that this wood-working plant is in use practically continuously with varying load; yet, in calculating the cost of current required if an electric motor were used (for which purpose he, in reality, *only guesses at the number of horse-power-hours*), he works on the basis that the plant should only be used when the work in the shop would give a steady three-quarter load, or thereabouts, thus requiring that the electric motor should only be used for 209 hours, as stated by him, as against the gas engine with 624 hours. Any person acquainted with a joiners' shop knows this is an impossible condition. One man usually works several tools in succession, and cannot do so simultaneously. The whole calculation, therefore, collapses, as, if the electric motor were run, as it clearly would be, for the greater number of hours, then, as the writer admits by inference in his last paragraph, the efficiency would be less and the cost per quarter more. Naturally, the motor will not carry its friction load for a greater number of hours without using more current.

Like your contributor I have some particulars of the cost of running a small wood-working plant; but with this difference, that my figures are obtained from practice, and instead of being assumed are taken from the actual charges made for current and gas respectively. They are as follows:—

Electromotor 460 Volts 40 Amperes.

Charge for current per quarter to March 19th, 1903 (say 11 weeks).

2,100 units at 3d.	£26	5	0
4,974 „ 1½d.	31	1	9
	£57	6	9
Less 5 per cent. allowed... ...	2	17	4
	£54	9	5

(It will be seen the average cost of current is less than 2d. per unit).

The motor was replaced by a gas engine to run the same plant in the same manner, but the engine was bought much larger in view of extensions, several lengths of main shafting added, and a building put up for more wood-working plant. The engine being underloaded, as the new tools were not yet bought, was at a disadvantage; but for the 12 weeks, April 15th to July 9th, the cost of gas at 2s. 3d. per 1,000 was £20 5 5

The comparison, therefore, is:—

Current average per week	£4	19	0
Gas average per week	1	13	9

I hear that the consumption of gas since has been slightly less, as might have been expected after the engine had had a few months' use.

I fancy your contributor has not grasped the fact that though there are uses for small electromotors as well as for gas engines, it is unsafe to generalise.

James S. Wylde.

Electricity in Mines.

Having read the letter of your correspondent, Mr. T. Campbell Futers, in the March 4th issue of the Electrical Review, and learnt that he does not apprehend danger from the sparking of brushes on continuous current motors at a coal face, I should like to suggest to him that there are many advantages to be gained by dispensing altogether with the compressed air engine and the electric motor, and adopting in their stead the petrol motor with electric ignition to drive his coal cutters, &c. I assure him that in making this suggestion to him, I have no personal axe to grind, and that I am so modest that I cannot take either responsibility or credit for the idea.

Mr. Futers will no doubt be able to logically demonstrate to the powers that be that there is in reality no danger in the use of such apparatus as I have described, or, at any rate, no more than there is in using a continuous current electric motor. He certainly would be able to convince his directors of the economy of a system which requires neither pipes nor cables. There would, if he adopted my suggestion, be none of those vexatious rules and regulations he complains of to trouble him or that long-suffering individual the colliery manager, except just those which would apply to that one little spark, and as a preliminary to obtaining permission to install boilers at his gate ends and cut coal with a steam engine driving his machinery, Mr. Futers will, I dare say, agree with me, the idea is "illegant."

The only task which would present considerable difficulty, would be the eradication of the firm conviction that a spark in a gassy mine constitutes a source of danger, be it from the commutator of an electric motor, or the secondary ends of an induction coil.

The aforesaid firm conviction has apparently taken root in the minds of the stupid public, and the more obstinate framers and enforcers of the Coal Mines Regulation Act

seem to base all their rules upon the assumption that this conviction is borne out by facts.

I am sadly afraid that Mr. Futers would not be able to convince these people of the fallacy of their opinions, but still, his continuous current motor sparking away day after day, should be sufficient evidence for the most obstinate—if he could get them to go near enough to see it.

If he is not sufficiently fortunate in this respect to enable him to adopt my suggestion, and is forced to look out for a motor which will *not* spark, I recommend to him the three-phase induction motor, and notwithstanding the assertion that it is not always possible to use it in thin seams, I think he will get satisfactory replies if he sends his inquiries to the right places. I can assure him that it is *always* possible to use a three-phase motor in a mine where continuous current motors can be used, and I have no doubt that by this time, if my knowledge of the enterprise of electrical manufacturers goes for anything, he will have received particulars from them which may have caused him to modify his opinion on this point.

The same particulars will also probably have enlightened him regarding the comparative initial cost of polyphase and continuous current machinery, and I may venture to say that the upkeep of the former type, if properly installed, will not cost more than 50 per cent. for any given uniform capacity, of the upkeep of the latter.

It is quite possible to point out disadvantages possessed by polyphase systems when compared with continuous-current plant and appliances, but when one takes into consideration the easy manner in which alternating currents can be transformed, the absolutely sparkless operation of the induction motor, and consequently reduced danger of explosion in places where the fear of explosion is not unfounded, and the risk terribly real if not always realised, one comes to the conclusion that the little defects are amply compensated for, and there is no doubt that alternating currents are the safest, and, therefore, the best which could be employed in mines.

F. J. Milne.

Pinxton, *March 7th*, 1904.

Fire Risk in Flour Mills.

As representative of a motor-manufacturing firm, I interviewed the manager of a flour mill *re* installation of electric motors, and was surprised to hear that 10s. per cent. (ten shillings per cent.) is charged extra for insurance if any are installed—*vide* Fire Office Committee Rules, June 4th, 1903.

In the interests of electrical progress, it would be satisfactory to have some explanation. Ten years since this may have been necessary; but in the present days of totally enclosed motors, to my mind it is extraordinary.

Possibly the expert engineers to the framers of this rule can advance some reason?

The particular mills I refer to, sometimes "shut down," but wish to use their "sack hoist," the electric supply is obtainable off the mains—should they have to pay £50 extra insurance (say £10,000 cover) to be allowed to use an absolutely safe machine costing about £25?

T. L. R. Puzzled.

Electrons and Meteorology.

The result of Mr. Don's experiments, appearing in the Electrical Review of March 4th, 1904, are of great importance, they certainly justify the suggestion made in a series of articles on "An Electrical Hypothesis for the Solar and Planetary Systems, and Some of their Associated Phenomena," appearing in the Electrical Review of April, 1898, under the *nom de plume* of "Delta," that a special society should be formed from the ranks of physicists, electricians, chemists, and from the medical fraternity along with experts in astronomy and meteorology to make day by day investigations, in various parts of the country, of the variations in the electrical conditions of the atmosphere, and correlate the accumulated results with associated meteorologic, astonomic, physical and hygienic changes.

It appears to me that if the members of such a society were equipped with Mr. Don's electronscope, a barometer with a thermometer attached, and a compass, they could immediately commence a geographically distributed investigation, the result of which might be productive of benefit to science and to the welfare of mankind.

Alpha.

ROYAL COMMISSION ON LONDON TRAFFIC.

At the sitting of this Commission on Thursday last week, evidence was given by Mr. F. B. Behr, the mono-rail inventor. He said that, in his opinion, if a central authority were created it should not only deal with the street traffic, but should determine what class of railways or tramways should be built. There had been many mistakes made in the past in designing means of communication in London. As an instance he mentioned the tube railways. In many places those tubes duplicated each other for considerable distances. In one case, that of the Waterloo and Baker Street tube and the Charing Cross and Hampstead tube, the lines ran for over a mile within an average distance of less than half a mile. The capitalisation of those tubes had now reached to the enormous sums of from £600,000 to £850,000 per mile, and it seemed impossible that many of the tubes could pay a fair dividend. It seemed to him undesirable to encourage, by the authority lent to a project by Parliamentary sanction, expenditure which must result in loss to the public, especially when the sums could be more advantageously devoted to the construction of overhead railways. The great prejudice created against overhead railways in London was due principally to the idea that they were very ugly and would disfigure the streets. He put in a set of photographs of the Berlin railways to show what effect such railways had upon the streets. It was quite possible to design, as had been done at Berlin in some instances, overhead railways with lines not going along the centre of the street, but at the back of the houses. He had designed a mono-rail line going from east to west through North London. The line would be 12 miles long, and would start from the Royal Oak by Edgware Road, and pass through St. John's Wood, Camden Town, King's Cross, Islington, Haggerston and Hackney, to the Albert and Victoria Docks. In connection with this line would be branch lines of a total length of over 5 miles, one going from the Royal Oak to Willesden Junction, another from Haggerston to Old Broad Street, and one going by Stepney to Limehouse. He submitted plans and sections of these railways, which he estimated would cost £100,000 per mile. He had also designed another mono-rail line to go from the Houses of Parliament to Putney Bridge Station along the Chelsea Embankment; that could be built for £25,000 per mile. Some of the advantages in using the mono-rail for purposes of street railways were its cheapness, the possibility of passing in many places under existing road bridges, the use of very sharp curves without much friction, the little space occupied in the streets, and the absolute impossibility of dersilment. Dealing with the question of tramways, witness said that he considered them to be very objectionable in many cases, owing to the obstruction they caused. Tramways should be avoided where possible, and should only be allowed in such streets where they would not impede, or be impeded by, the other traffic.

Mr. Francis Fox (Sir Douglas Fox & Partners), who has had a large experience of tunnelling work, was then called. He desired to corroborate the evidence given by his brother, Sir Douglas Fox. With regard to shallow subways he said that he would be a strong advocate for them where the conditions were suitable. They would be suitable under new and very wide streets, but the proposal to construct them under the existing streets of the Metropolis was fraught with very great danger to adjacent property. The cause of this was the fact that they would have to be made in the gravel, and the necessary pumping would tend to undermine the surrounding property by drawing away the sand. Compressed air could not be used so near the surface. The witness gave several illustrations of accidents which had occurred in works of this kind. To obviate such effects passing under the Metropolis the late Mr. Greathead adopted the system of deep level tubes, which traversed the clay. To abandon that system and to revert to shallow tunnel construction, would, in witness's opinion, be taking a retrograde step. Continuing, he said that for years past he had had to deal with the question of the ventilation of mines, railway tunnels, &c. On railways where steam locomotives were used, the question of the products of combustion was a very important matter, but this did not come in in the case of tube railways. In the case of the former tunnels, the proportion of CO_2 could be kept as low as 20 parts in 10,000 but such a proportion should be considered quite inadmissible in the case of an electric tube, and he then went into the question somewhat fully, saying, in conclusion, that to ensure healthy ventilation during periods of dense traffic, such as occurred on Bank Holidays, &c., the entire air should be changed every hour. Proceeding, he dealt with the precautions taken to prevent fire and panic, and said that most of the necessary precautions had been adopted on one or other of the London Tubes before the fire on the Paris underground. One important point was that there should be an absence of guttapercha or other inflammable and smoke-producing material in the insulation of cables and wires: all such leads and circuits should be covered with iron or other non-flammable material.

On Friday evidence was given by Mr. J. F. S. Gooday, the general manager of the Great Eastern Railway. He corrected statements made by previous witnesses who had said that workmen's trains were remunerative to railway companies, and from which statements the inference might be made that it would be fair to impose upon the companies the duty of providing further accommodation at fares of 2d., or so, for the return journey. The

Great Eastern had never admitted that those workmen's fares paid. The receipts per train-mile from workmen's trains at the present time was 3s. 3·2d. The expense of working in the suburban districts of London was far greater per train-mile than the average for the whole line, owing to the following matters: Short sections, shorter hours of labour, heavy train loads, and frequent stopping, larger number of stations.

Sir Henry Oakley, the chairman of the Central London Railway, said that it was impossible to decide whether a man was a workman or not, and any one arriving at a station before 7.30 a.m. would be entitled to a return ticket at single fare. Referring in detail to the working of the line, he said that the lifts worked satisfactorily and economically, the cost of maintenance and working being about 8 per cent. of the total working expenses. If in future tube railways, booking halls under the pavement were allowed, as in Paris, and at the Bank station of the Central London Railway, a saving in cost of construction would be effected.

PARLIAMENTARY.

St. Marylebone Electric Lighting Bill.

On Thursday last week the Court of Referees, under the chairmanship of Mr. Parker Smith, M.P., sat to consider, amongst other matters, the claim of the Metropolitan Electric Supply Co., Ltd., for a *locus standi* against the St. Marylebone Electric Lighting Bill. Mr. Balfour Browne, K.C., represented the company, and Mr. H. Lloyd, K.C., was for the Marylebone Borough Council, who objected to the *locus* being granted.

Mr. Balfour Browne, in opening the case, went into the history of the electric lighting question in Marylebone, which ultimately led to an arbitration between the company and the local authority, when the arbitrator fixed the price of the company's undertaking to be purchased by the Borough Council at £1,212,000. The company had taken proceedings to enforce payment, and had obtained a judgment order, but this had been suspended from time to time. In the Bill now being promoted by the Borough Council, the object sought was power to raise money for completing the purchase, and he had no objection to that. But the promoters had included other clauses in the Bill, and asked to be allowed to raise about £600,000 for fresh works. As the Council now owed his clients £1,365,000, they were afraid this £600,000 might be made a prior charge on the rates to their judgment summons.

Mr. Greene asked if the company could not get a sequestration order.

Mr. Browne replied that nobody seemed to know exactly what the sequestration of a corporation meant. He did not think it would have a more terrorising effect than the award seemed to have had upon the Council. He had never heard of a receiver being appointed for a corporation.

Mr. Brynmor Jones remarked that he had always understood that the Court of Chancery could appoint a receiver to carry out any order of the Court.

Mr. Browne said, of course, he wanted the Corporation to raise the money, but he also wanted it made perfectly clear that, if they got power to raise it, they must pay him. As a matter of fact, there was nothing in the Bill to compel the promoters to pay the petitioners. Only quite recently they had had the case of a corporation raising money for one object and applying it to an entirely different object. If a clause were put in the Bill, it would become a statutory duty on the part of the Council to pay the company, and should they commit a breach of that duty, the Attorney-General would have something to say.

Mr. Lloyd characterised the contention of Mr. Browne that a judgment creditor was entitled to a *locus standi* against the Bill of a local authority to raise money, as a monstrous proposition. The company would be in exactly the same position as they were now if the Bill were passed.

Mr. Paulton asked what was the objection of Mr. Lloyd to giving the clause asked for?

Mr. Lloyd said the Corporation were under an order of the Court to pay, and they had moved heaven and earth to pay. They had tried to borrow the money from the County Council, and failed, and they could not pay until they had obtained an Act of Parliament.

After deliberating for some time the Court, by a majority, disallowed the *locus* of the company.

Kettering Electric Lighting.

On Tuesday a Select Committee of the House of Commons considered the Kettering Improvement Bill, promoted by the U.D.C.

Mr. Vesey Knox, who appeared for the promoters, said that with regard to the electric lighting portion of the Bill, Clause 5 dealt with the question of free wiring, and the Council asked for powers to expend money on wiring a number of houses in the town. Where well-to-do persons were being supplied with electricity there was no difficulty with regard to wiring, but in the case of persons with small capital it was a matter of great importance.

Mr. Boyce, who represented the Local Government Board, said it was not free wiring.

The Chairman: It is paid for in the rental.

Mr. Vesey Knox said the matter was discussed in the previous session in the Bill of the Beckenham Urban District Council, and after hearing evidence, the Committee allowed £20,000 to be expended in that way. Clause 14 of the Bill was one with regard to which there was no precedent, and what was asked for was that the provision of the Public Health Act with respect to the purchase of lands by a local authority should, as applied to Kettering, be deemed to be extended so as to include the purchase of land for the electricity undertaking of the Council. In other words, they asked that authority should be given to the Local Government Board to grant the Council compulsory power to purchase a piece of land adjoining the generating station, at some future period. The comment of the Local Government Board on that was that such a change ought to be made by the general law. The circumstances, however, in this case were special. The site chosen for the generating station was a convenient one in the centre of the town, and adjoining it was some land which the Council did not want at the present moment, but which would be necessary for an extension of the station at some future period. If the Council bought it now they would be saddling their electric lighting undertaking with a considerable amount of unremunerative expenditure and they were aiming to keep down such a burden. On the other hand, they might not be before Parliament again for many years, and so they asked that the Local Government Board should be empowered to give them compulsory powers to acquire the land when it was required. If they asked in that Bill for compulsory powers they would only get three years, and they did not expect to want the land within three years.

Mr. Bond, Clerk to the Urban District Council, was called, and said the Council had already borrowed £12,352 for their undertaking, but had still considerable unused borrowing powers. They obtained their order in 1896, and were advised by Prof. Kennedy, and the undertaking was being carried on under the guidance of Messrs. Kennedy and Jenkin. They were not yet supplying electricity, but had had applications for the free wiring of houses.

Mr. C. Saunders, Chairman of the Kettering U.D.C, said it was absolutely essential for the welfare of the town that they should have the power to supply motors and wiring. He did not think unless they had such powers they would make the undertaking remunerative for some years.

Replying to Mr. Whitley (one of the Committee), Witness said they estimated that, of the 6,000 houses in Kettering, 400 would require free wiring, and this would cost £10 per house. He had not worked out what the estimated profit would be for such houses, but, on the whole undertaking, the estimate showed a profit. It was proposed to charge 4½d. per unit for lighting and 1½d. per unit for power after the first 2,000 units. For the first 2,000 units 2d. would be charged.

In answer to Sir T. Fardell, Witness said the 820 houses and shops proposed to be free-wired would work out at £13,000. With regard to the motors, which were estimated to be let out on the hire system, the total was made up as follows:—30 ½-H.P. motors, £900; 25 1-H.P. motors, £1,000; 20 3-H.P. motors, £1,200; 20 5-H.P. motors, £1,600; and 20 10-H.P. motors, £2,200—total, £6,900. They had at present spent about £33,500 on mains and stations.

Prof. Kennedy said he had advised the Council as to the best way of developing the supply of electricity in the district, and his original estimate for electrical plant and mains, was £30,000. They asked for power for £32,600, excluding buildings, and of this, mains were about £8,000. The present buildings would hold about 2,400 H.P. which would provide current for an equivalent of about 70,000 lamps. The actual plant which was being put in was only 750 H.P. He thought it desirable that in some way the Council should have a call on the adjoining land, but they would not want it for five or six years. Kettering differed a great deal from many towns in the matter of having a large industrial population and small industrial enterprises, and he pointed out to the Council that if the scheme was to be made successful they should be able to supply motors for industrial concerns. The present estimate for 365,000 units seemed to be reasonable. Personally, he attached more importance to letting motors on hire than to free wiring. His original estimate was for 367,000 units per annum, with a revenue of £5,875; and, after paying all interest and sinking fund, that would have left a balance of £1,085. Since that time the Council had decided on a lower price per unit, which would leave a smaller balance.

Mr. Knox pointed out that they only asked for a period of 10 years for the repayment of the loan for wiring.

Mr. Boyce objected to the words "electric lines" in the clause, and suggested that for the sake of uniformity the word "wiring" should be substituted.

Mr. Knox pointed out that in the Electric Lighting Acts the definition of the words "electric line" included wires, &c. What they were anxious for was to get powers to let motors on hire.

Mr. Lees, Parliamentary agent for the Bill, and chairman of the Beckenham U.D.C., said that in Beckenham they had the clause, and the way it was carried out in Beckenham was this: If a person wired his own house, he paid 5½d. per unit, and if it was wired by the Council he paid 3d. per unit. In addition, if he did not consume a certain amount, he had to pay something in the way of rent for wiring.

The Chairman asked what had been the experience of the system financially?

Mr. Lees said they would never have got the demand they had were it not for the system. They opened their works in November, 1900, and within 18 months reached their full capacity. They originally spent £30,000, but had now spent £70,000. They were advised that these wires would last 30 years, for they were placed in tubes in the casements, and were not touched, and required no maintenance.

The Committee passed the wiring clauses with some small alterations of the wording. The clause relating to the compulsory powers for the purchase of land was not passed.

London United Tramways.—The opposition of Ealing Corporation, the Bucks. County Council, the Surrey C.C. and the Great Western Railway Co. to this Bill has been withdrawn.

Lincolnshire and Yorkshire Electric Power.—The Great Grimsby Gas Co. and the Great Grimsby Waterworks Co. have withdrawn their opposition to this Bill.

Great Northern and City Railway Bill.—This Bill came before Mr. Jeffrey's Committee on Unopposed Bills on Friday. The object of the measure is to extend the time limited by the Companies' Acts for the compulsory purchase of land and for the completion of the authorised railway, and also for the payment of interest out of capital within the extended time, which is 1907. There being no opposition, formal proof of the preamble was given and the Bill was ordered to go forward for third reading.

Petitions Withdrawn.—The following petitions in opposition to Private Bills have been withdrawn:—The East London Waterworks Co. to the North and South Woolwich Electric Railway Bill; the North Cheshire Water Co., to the Cheshire Electricity and Power Gas Bill; the Southwark and Vauxhall Water Co., to the London, Camberwell and Dulwich Tramways Bill; and the Wandsworth Gas Co. to the L.C.C. Tramways Bill.

St. Marylebone Electric Lighting Bill.—The Standing Orders Committee of the House of Commons have decided that the standing orders shall not be dispensed with in the case of the Gas Light and Coke Co., so that the company will not be permitted to proceed with their opposition.

Shipley U.D.C. Bill.—On Tuesday this Bill was ordered to go to the House of Lords for the third reading.

Tynemouth Corporation.—This omnibus Bill makes provision to amend the Electric Lighting Act, 1882, for the filing and making up of the annual statement of accounts of the electricity undertaking, came before a Committee of the House of Lords on Tuesday, and, being unopposed, was committed for third reading.

Govan Burgh (Electricity).—This Bill, which was promoted as a Scotch Provisional Order, and was ordered to be proceeded with as a private Bill, came before the Unopposed Committee of the House of Lords on Tuesday, and was referred to the House for third reading. It confers further powers on the local authority in the way of supplying electric fittings, the making of special charges to premises being separately supplied, &c.

Isle of Thanet Light Railways Bill.—This Bill will not be proceeded with. The proposal of the company was to supply authorised undertakers outside the limits of supply.

Chesterfield Corporation Tramways Bill.—On Tuesday a Select Committee of the House of Lords, under the chairmanship of the Earl of Crewe, considered the Chesterfield Corporation Tramways and Improvements Bill. During the hearing an amicable settlement was arrived at with the only opponents (the Derbyshire County Council), and the preamble of the Bill was then declared proved.

LEGAL.

St. James's and Pall Mall Electric Lighting Co., Ltd., *v.* The King.

This case came before Mr. Justice Farwell, sitting as an additional judge of the King's Bench Division, on Tuesday. Mr. Cripps, K.C., Mr. R. J. Parker, and Mr. Llewellyn Davies appeared for the company; and Mr. Clavell Salter, K.C, and Mr. John Harris for the King.

Mr. Cripps said that the case really raised a question as to the liabilities of the Postmaster-General or his contractors, because the ultimate liability would be upon them under the Telegraph Acts. Under the Act of 1863 the Postmaster-General was entitled to carry out certain works in respect of telegraphic or telephonic communication, with a liability to compensate anyone who might be injured in the carrying out of those works. In carrying out certain works in January, 1902, a certain injury was done to a water-pipe which resulted in the flooding of a main of the plaintiff company, whereby short-circuiting occurred, and a good deal of injury was done. Upon that, the company took steps to have the amount assessed before a Compensation Jury under the Telegraph Acts. The amount had been assessed at the sum of £145 19s. 6d., and the only question involved at all was whether there was jurisdiction for a compensation jury to deal with a question of this kind. If they had jurisdiction, the amount was determined. Compensation was only for recoupment of the expense the company had actually been put to in remedying the damage by the breaking of the water pipe. The issue was an important one, affecting all electric lighting companies, namely, whether damage as suffered under the conditions as in the present case was damage in respect of which compensation could be claimed under the Telegraph Acts of 1863 and 1868. Counsel argued that so long as the work was done and so long as the damage was sustained by reason and in consequence of the powers conferred by the Acts it was not material whether there was negligence or not. He contended that no one against whom compensation was claimed because of damage sustained as a consequence of statutory powers could set up a defence that the damage resulted from what might be called negligence.

Mr. R. J. Parker followed on the same side.

Mr. Salter, K.C., replied for the King.

At the conclusion of the arguments of counsel, His Lordship gave judgment. After reading the sections of the Acts bearing on the point, he said the only fact that he had got before the Court was a statement contained in a letter dated Jan. 30, from the Post Office Authorities admitting that the damage done was by the department's contractors. Mr. Salter had said that the damage was really occasioned by the negligent exercise of the powers of the Acts. Neither side said that there was anything *ultra vires*, but the Postmaster-General said that the contractor's workmen in carrying out the powers of the Act, acted negligently, and that for the negligent exercise of statutory powers a common law action was the remedy. In cases of this class it was obvious that the onus of proof practically went to the root of the whole matter. But, taking the view that he did that when negligence was intended to be set up as an answer to that which was otherwise a *prima facie* case for compensation, the onus of proving negligence lay on the respondents. There was, therefore, no practical difficulty in his way in the present case. The result was that in his opinion the company succeeded. Both parties agreed that the taxed costs of the proceedings before the Sheriff should be added to the amount of compensation.

On the application of Mr. Parker, the company were given the costs of the present proceedings.

Electric Tramways Construction and Maintenance Co., Ltd.

In the Chancery Division of the High Court of Justice, on Tuesday (March 8th), before Mr. Justice Byrne, the petition of F. H. Barr and Others for the winding up of this company was dismissed without costs.

BUSINESS NOTES.

Rhodes E.M. Co.'s Alternate Current Motors.—The Rhodes Electrical Manufacturing Co., now Ltd., who commenced placing their R.E. type direct current motor on the market some two years ago, account for their successful development by the manufacture of a commercial machine, at reasonable prices, and, most important of all, by prompt delivery and general attention to each detailed requirement. It is their boast that they can deliver a machine to any voltage or speed within 10 days, and in many instances special machines have been produced within four or five days. The secret of this quickness of delivery is in their factory organisation, they building only one type of machine, and this being of thoroughly sound mechanical construction. For the last few months the Rhodes Electrical Manufacturing Co., Ltd., have been experimenting with alternating current machines, and they are shortly placing on the market three distinct types of alternating current motors for single, two and three-phase currents; it is their intention, as soon as they have standardised these machines, to supply as good a machine and effect as prompt deliveries as in the case of their R.E. type direct current motors. The different types of A.C. motors which at the present moment they are building are:—(1) A short-circuited rotor machine, of the squirrel-cage type, single, two and three-phase, up to 5 H.P., which will be called their "R.S." type; (2) a hand-wound rotor with slip rings, for single, two and three-phase, to be known as their "R H." type, the single-phase motor starting up as a split-phase motor; (3) their "R.F." type motor, a single-phase alternating current machine with a very powerful starting torque, which is intended to be used in conjunction with lifts, and so forth, and will operate in as satisfactory a manner as far as starting is concerned as a direct current machine. The normal starting current with a full load torque will not exceed full load running current, consequently this will meet public supply companies' regulations. The type of this machine will be that of a repulsion and induction motor combined. We wish this enterprising young firm every success in their new venture.

Scottish Electrical Contractors.—The first annual dinner of the members of the Scottish Electrical Contractors Association was held in the Grosvenor Restaurant, Glasgow, on Wednesday, 2nd March, when a very successful evening was passed. The company included the electrical contractors, representatives of the manufacturers, and representatives of the Corporation Tramway and Lighting Departments. In the regrettable absence of Mr. Wright, the president of the Association, through illness, Mr. McWhirter occupied the chair, and Mr. W. C. Martin acted as croupier. An enjoyable evening was spent in speeches and music.

The Lilliput Arc Lamp.—We understand from Messrs. Siemens Electric Appliances, Ltd., that owing to increasing output the works cost of this lamp has been so decreased as to justify a reduction in the selling prices, of which a revised list is just issued.

Dartford Destructor.—A Meldrum destructor is at work at Dartford. We understand that a saving of 400 tons of coal per annum is being made, although the quantity of refuse is only 13 tons per day.

Private Telephone System.—The tender of the Private Wire and Telephone Installation Co., Ltd., has been accepted for installing a complete system of automatic intercommunication telephones in the new offices of the *Engineer*, now nearing completion in Norfolk Street, Strand.

Electrical Wares Exported.

Week ending Mar. 10th, 1903.		Week ending Mar. 8th, 1904.	
Adelaide	Value £2,721	Adelaide	Value £134
Amsterdam	85	Alexandria	141
Auckland	40	Amsterdam	58
Bangkok	42	Bombay	109
Boca	4,289	Buenos Ayres	85
Bombay	104	Calcutta	308
Buenos Ayres	8,063	,, Teleg. mat.	25
Calcutta	1,007	Cape Town	154
Canada, *via* United States ..	23	,, Teleg. mat.	957
Cape Town	923	Colombo	111
Colombo	147	Durban	1,142
,, Teleg. mat.	206	,, Teleg. mat.	484
Delagoa Bay	98	East London	433
Durban	1,841	,, Teleg. mat.	245
Hamburg	14	Fremantle	38
,, Teleph. mat. ..	110	Gibraltar	300
Hong Kong	22	Halifax	90
Madras	9	Lisbon	20
Malta	10	,, Teleph. mat.	190
Melbourne	423	Lyttelton	19
North Atlantic. Teleg. cable ..	2,150	Ostend	17
Odessa	83	Perth	143
Oporto	5	Port Elizabeth	45
Ostend	26	Rosario. Teleg. mat.	393
Perth	146	St. Petersburg. Teleg. cable ..	110
Port Elizabeth	187	Shanghai	62
,, ,, Teleg. mat. ..	9,734	Sierra Leone	48
St. Petersburg	60	Singapore	60
Sydney	865	Stockholm	22
,, Teleg. mat.	145	,, Teleg. mat.	11
Vera Cruz	2,551	Sydney	193
Wellington	4,630	Tientsin	22
,, Teleg. mat.	2,401	Wellington	106
Yokohama	413	Yokohama	245
Total ..	£43,578	Total ..	£6,520

Foreign Goods Transhipped.

Cape Town.	Telephones	Value £110
Gothenburg.	Elec. apparatus ..	34
New York.	Elec. motor ..	1,200
Total ..		£1,314

New Negative Plate.—We understand that the Chloride Electrical Storage Co., Ltd., are now supplying their new negative plate, known as the "Exide," which embodies several improvements in design and detail. They are also sending out their new type of board separator. This takes the place of the glass rod separators which were formerly employed, and entirely prevents any short-circuiting from plate to plate.

New Primary Cell. — After a series of exhaustive experiments, the General Electric Company, Limited, are now placing upon the market a new cell which has been specially introduced to meet a want for a dry cell which could be kept in stock for an indefinite period without deterioration. They have termed it "The Extra Sec E.C.C. Cell." This battery, we understand, contains all the necessary ingredients for satisfactory working, with the exception of the exciting fluid, and it is only necessary to pour a saturated solution of sal ammoniac into the opening provided for the purpose to excite the battery, and render it ready for use. In one form the sal ammoniac solution is received by an absorbent material which prevents its escape even although the cell be upset. In another type this absorbent material is absent, and, consequently, if the cell is required to be put out of action for some considerable time the sal ammoniac solution can be poured out, to be replaced when the cell is again required for use. It is claimed that the output obtained from the battery is large, each cell being capable of giving continuously a current of one-tenth of an ampere for 380 to 400 hours. The electrodes are so arranged as to be extremely close to each other; at the same time the construction of the cell renders damage from short circuit impossible, and the arrangement is such that the supply of the sal ammoniac solution between the electrodes is well maintained when once it is excited, these two facts reducing the internal resistance to a minimum. As the cell can be stocked for a long time without deterioration, it is specially serviceable for use in hot climates and for export purposes generally.

Steel Flat Link Chain.—Chains of the sprocket-wheel variety have been made in the past from malleable cast-iron, or even from plain cast-iron, and they have been more or less liable to fail from flaws and brittle links. A steel chain has been introduced by the Locke Steel Chain Co., and a demonstration of the working of the presses took place at Tottenham some time ago. The process and the presses on which the process is carried out are very interesting. The chain is of the flat solid-link type, each link consisting of an eye and bar connected by two strips. The eye of one link encloses the bar of the next link, and so on. The whole of the links are detachable and interchangeable at will. This can only be done, however, when the links are bent at right angles, and this ensures the chain from falling apart when at work.

In the process of manufacture the end of a coil of ribbon steel is introduced into the press. As the dies act upon it, it is moved automatically forward the distance of a link, and as each link is completed, it is joined up to the preceding one. Three links are apparently operated on almost simultaneously. One die heavily indents that portion of the ribbon which eventually forms the eye. This eases the work of the next die which forces the strip through, and gives it a slight lead upward. A movable-bottom die completes the upward turning movement, and so forms the eye. At the moment this operation is performed, the bar of the last-formed link drops into it, and is enclosed, so that there is no really distinct break from the introduction of the ribbon, until the length of chain is completed, and coiled away on the drum of the machine. The bar end of the link is formed at the point where the eye strip has been forced away, and a slight movement of a following-up die hoops it, and severs it so that the next impulse makes it ready to take its place in the eye in process of formation.

The presses are of a very powerful and heavy type, and the whole process goes forward without jarring or noise, at the rate of 35 links per minute, and as the chain is coiled away, it is practically a completed article.

After completion the chains are hardened and tempered in oil by heating to 500° F., a process which toughens the chain and ensures a thorough soaking of oil, so as to ensure that chains shall go out ready greased. The finished chain is tested, and slightly stretched to its exact pitch. The curious part of the process is that no waste is made. The whole of the steel strip appears in the finished chain.

From what we saw of the process, and from the samples of chain made, we think the future of this chain should be assured. Every process is automatic. In the finishing process the chain is drawn through a gas furnace at the rate of about 7 ft. per minute, and arrives cherry red at the quenching tank. The quenched chain is wound into a coil, which is, as above described, heated in oil, and finally tested. If a defective link is shown up, the machine stops automatically for removal of the bad link. A certain chain breaks at 2,000 lbs., whereas a malleable chain of equal section breaks at 1,700 lbs. The hardening and tempering process is claimed to increase the strength 100 per cent.

Esperanto.—We have received a letter from the Hon. Secretary of the Esperanto Club (Mr. H. Bolingbroke Mudie, of 67, Kensington Gardens Square, W.) referring to this subject, from which we learn that an *Internacia Sciensa Revuo* has just been issued, which is intended to contain the leading features of all scientific publications translated into Esperanto. We fear that the projectors of this journal hardly realise the immensity of such an undertaking. However, it will be an advantage to have even a few of the most noteworthy scientific events and advances of the world brought together in a common language, and we wish the editors the success which we feel sure they will merit. Full particulars of this and other publications of the London Esperanto Club can be obtained from the Librarian at 41, Outer Temple, W.C.

Maxim Lamp Contract.—The Sir Hiram Maxim Electrical and Engineering Co., Ltd., has received a contract for a year's supply of lamps to the Heath Asylum, by the London County Council Asylums Committee.

Four-Way Distribution Fuseboard.—We have received from Messrs. Fuller, Macleod & Co., of 9, Red Lion Court, E.C., a sample four-way distribution fuseboard. Each of the ways is on a separate porcelain slab, the bridges being the firm's registered design open groove type, in which the fuses are clearly visible from the front. The clips, terminals (arranged in front) &c., are of solid construction, and as all the connections to the terminals are brought up to the front, faulty workmanship at those points should be eliminated. The arrangement of wiring also very much facilitates erection as compared with the type on which branch wires are pushed through from behind. The quality of the workmanship appears to be very good, and we are informed that the price is comparatively low.

"Saveye" Adjustable Lamps.—These lamps, which are specially suited for desk and picture lighting, and are adaptable for reading standards, typewriter lighting, or for orchestral purposes, secure comfort for the user, because they concentrate the light rays directly upon the work, book or music. The fitting has an eye-shade, which serves also as a reflector, and may be moved with ease to any desired angle. The inner glass cylinder, which can be turned by means of a small knob, has a clear and ground-glass surface. The "Saveye" lamps are being supplied by Messrs. Falk, Stadelmann and Co., Ltd., of 83—87, Farringdon Road, E.C., and a variety can be seen at their showrooms at that address.

Book Notices. — *The Motor Manual*, by the Editors of the *Motor*. London: Temple Press, Ltd. 1904. Price 1s. net. This little handbook has now reached its sixth edition, and, judging from its contents, deservedly claims a place on the bookshelf of any motorist who is not yet convinced that he knows everything connected with motor engineering, and even experts who know it all may find it a friend in need. Its contents are many and varied, and its price small. We need only say that the petrol motor and its application to the bicycle and the car are clearly explained; that the steam car is briefly described; that the construction of the electrical car and the arrangement of the numerous electrical firing devices at present in use are made clear, and throughout the book the practical hints on working are as much to the fore as the descriptive element. The book contains 118 pages and 117 illustrations, and to anyone interested in motoring is excellent value for the money.

Modern Electric Practice, Vol. II. Edited by Magnus MacLean. London: The Gresham Publishing Co. 9s.

X-rays Simply Explained. By R. P. Howgrave-Graham. London: Percival Marshall & Co. 6d. net.

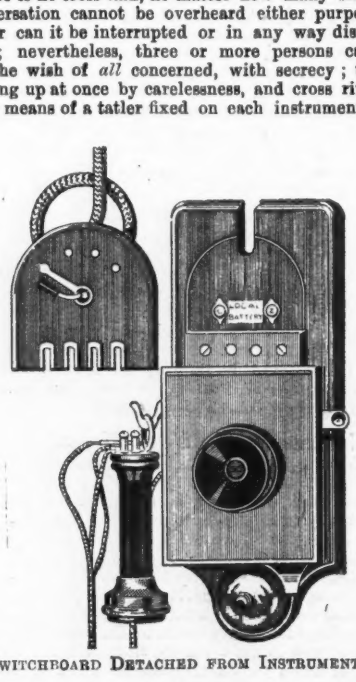
Specifications for Architects, Surveyors and Engineers when Specifying (No. 7, 1904). London: Proprietors of the *Builders' Journal and Architectural Record*. 3s. 6d. net.

Fire.—Shortly after 7.30 on Monday night, a slight fire was discovered in the upper storey of Messrs. Veritys' Victoria Works, Aston. One-third of the roof of Victoria Works was destroyed, but beyond this, little damage was done; for the most part this manufactory, as well as the firm's Plume Works, is in full operation, and it is not anticipated that any inconvenience will be caused to customers by the mishap.

Secret Circuit Intercommunication Telephones.—While the modern intercommunication telephone system is a priceless boon in large establishments, it has many drawbacks, one of the worst of which is the lack of privacy and the liability to interruption by other persons whilst a conversation is in progress. The

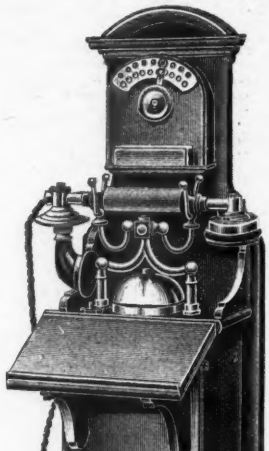
Table Telephone.

difficulties in the way of securing perfect secrecy and isolation were apparently almost insuperable, without incurring great expense; the Parsons-Sloper system, however, made by the old-established British firm of Gent & Co., at Faraday Works, Leicester, successfully overcomes these obstacles, and combines the following advantages:—There is no cross-talk, no matter how many stations are in use; a conversation cannot be overheard either purposely or by accident, nor can it be interrupted or in any way disturbed by a third party; nevertheless, three or more persons can converse together at the wish of *all* concerned, with secrecy; two stations cannot be rung up at once by carelessness, and cross ringing is impossible; by means of a tatler fixed on each instrument, the caller



Switchboard Detached from Instrument.

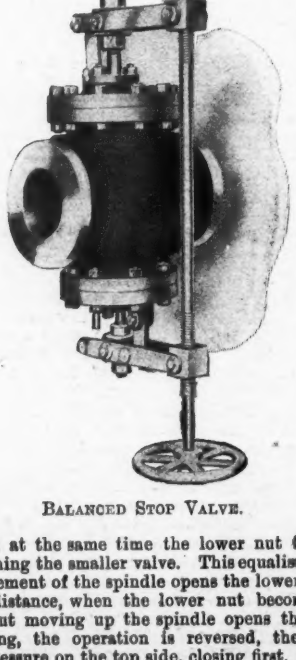
hears when the distant bell is ringing, and therefore knows at once whether the distant station is engaged, whether the person calling is absent, and when he is at his instrument. These advantages, which render the system invaluable to a busy man, are secured in an extremely simple manner, without the use of any complicated device. Briefly, the essence of the system is the fact that while a common battery is used for ringing, local batteries are used for speaking, and by the action of a relay in each instrument, directly communication is established the two parties concerned are entirely isolated from all other stations. No additional wires are required, as compared with ordinary systems, nor are the station instruments larger or less pleasing in appearance. The accompanying figures show the table and wall telephone sets used for direct call secret intercommunication service. The special "underdome" loud-ringing bell, made by Messrs. Gent & Co., Ltd., and the spring selector switch, which cannot make two contacts at once, nor be left between contacts, are shown on both these figures (magneto ringing is not used). The third figure illustrates the detachable switchboard, which enables the instrument to be disconnected or reconnected without possibility of confusion, by means of four screws only—no matter how many stations may be comprised in the system. Lack of space forbids our dealing with the many interesting points connected with this



Wall Telephone, with Battery Box.

system and with other apparatus, made by Messrs. Gent & Co., which we saw on the occasion of a recent visit to their showrooms at 3A, Upper Thames Street, E.C.

Green's Patent Balanced Stop Valve.—Messrs. Holden & Brooke, Ltd., of Sirius Works, Manchester, whose numerous specialities have found practically universal applications in connection with steam plant are introducing a new type of balanced stop valve. It consists essentially of two valves arranged as in the ordinary "double-beat stop valve"; the upper one, however, being much larger than, and moving independently of, the lower one. A hand-wheel spindle, with right and left-handed threads fitted with nuts at either end, is arranged outside the valve. The two nuts are connected through levers to the valve spindles, with the valves at their upper and lower extremities. The operation of rotating the hand wheel causes the spindle to travel downwards through the upper nut (held stationary by the



Balanced Stop Valve.

large valve), and at the same time the lower nut to travel down the spindle, opening the smaller valve. This equalises the pressure, and further movement of the spindle opens the lower valve through a pre-arranged distance, when the lower nut becomes stationary, and the upper nut moving up the spindle opens the upper large valve. In closing, the operation is reversed, the larger valve, which has the pressure on the top side, closing first.

Among the many advantages claimed for this type of stop valve, are the fact that no force (beyond that required to overcome friction) is necessary to open the valve, and fine adjustments are therefore possible; the two valves being independent of each other, are effectually closed, cannot chatter, and are unaffected by a variation in the distance between the valve faces, due to expansion or other cause. The smaller valve can be used without opening the larger

one, and thus fulfil the functions of a bye pass for warming up, &c. It is claimed that this valve is especially suited to high steam pressures, and that it effectually overcomes leakage difficulties resulting from unequal expansion.

Dissolutions and Liquidations.—The matter of the Electric Timber Seasoning and Preservation Co., Ltd., came before Mr. Justice Byrne in the Companies Winding-up Court on Tuesday, on the petition of Louis de Lazin, formerly the secretary of the company. Mr. Vernon, on behalf of the company, said he was not in a position to oppose the petition. There were debentures issued to the amount of £50,000 which were a first charge on the whole of the assets, and it was doubtful whether anything would be got by realisation. Mr. Cartnell, in support of the petition, said that the evidence was that there would be a surplus. His Lordship made the usual winding-up order.

In the Chancery Division, before Mr. Justice Byrne, an order for compulsory winding-up of the McGuire Manufacturing Co., Ltd., was made. The first meetings of creditors and contributories respectively are to be held on March 22nd at Carey Street, W.C.

The liquidator of D. Stewart & Co., Ltd., of Glasgow, estimates that from the only remaining unrealised asset, for which an offer has been received, a final dividend of 1s. in the £, or thereabouts, may be payable.

For Sale.—Messrs. Farebrother, Ellis & Co. will, on March 24th, offer certain manufacturing premises at Kilburn for sale by auction. Croydon Corporation is inviting offers for three rectifiers. See our "Official Notices" to-day.

Electricity in Collieries.—We understand that Messrs. Ernest Scott & Mountain, Ltd., of Newcastle-on-Tyne, have some large contracts in hand for electrical transmission of power machinery, among the most important being the following:—For the Horden Collieries, Ltd., Shotton Colliery, near Castle Eden, two of their enclosed central-valve compound engines of 400 I.H.P., direct coupled to 250-KW. multipolar continuous current generators. For the Moss Bay Hematite Iron Co., Beckermet Mines, in Cumberland, the firm have a contract in hand for two coupled compound horizontal steam engines, each of 300 I.H.P., driving by ropes on to two 200-KW. continuous current generators. These plants are to supply current to two main shaft pumps (Scott & Mountain), fitted with gun-metal rams each 9 in. diameter × 15 in. stroke, delivering 250 gals. of water per min. against a head of 1,300 ft. The pumps are driven by two electric motors, each of 140 B.H.P., and the plant includes the main and distributing switchboards, cables, and electric lighting at the mine. For the Charlow and Sacriston Coal Co., the same firm have in hand one of their enclosed central-valve compound engines of 120 B.H.P., direct-coupled to an 80-KW. continuous current dynamo for supplying current to electric coal-cutting machines in the colliery; also a duplicate dynamo for coupling to an existing steam engine. For H. Stobart & Co., Etherley Grange Colliery, the firm have in hand an endless rope haulage gear for working two roads, this gear being driven by an electric motor of 30 B.H.P. For the West Durham and Wallsend Coal Co.'s Adelaide pit, Shildon, they have in hand a three-throw mining pump of large size, the rams being each 12 in. diameter × 15 in. stroke, these pumps delivering 600 gallons of water per minute against a head of 600 ft., and driven by an electric motor of 150 B.H.P. For the Stockingford Colliery, near Nuneaton, the firm have in hand an electric pumping plant consisting of a 150-KW. continuous-current generator which supplies current to a quadruple centrifugal pump, delivering 300 gallons per minute when four pumps are working in series, or 600 gallons per minute when two are working in series and two in parallel, the pumps being arranged one on each side of the motor, which is of 75-B.H.P. We also understand that this firm have lately taken up again the manufacture of electric coal-cutting machines, of which they made a speciality some years ago. The new type of coal cutter is the result of many year's experience of the requirements in actual colliery work, and we understand that several machines have already been purchased by local colliery owners.

Some Brush Contracts.—The Brush Electrical Engineering Co. has secured the following contracts:—

Isle of Thanet Tramways Co.—Twenty single trucks for tramcars. County of London Electric Lighting Co.—Six 24-KW. transformers. Blackpool Corporation.—Series of continuous-current motors for destructor works. La Carrosserie Industrielle, Paris.—Six single trucks for tramcars.

Trade Announcements.—Mr. Douglas C. Bate has been appointed sales manager to the Electric and Ordnance Accessories Co., Ltd., Stellite Works, Birmingham. This company has bought the goodwill of the Stewart Electrical Syndicate from the liquidators, also certain rights in the new Stewart, and will shortly put on the market a lamp embodying many of the best features of the Stewart lamp, and improvements suggested by Mr. Bate's long experience with that lamp. With the splendid equipment of the E. & O.A. Co. for turning out this class of work, and the manager's knowledge of customers' requirements, they should have little difficulty in building up a successful lamp department to supply a reliable lamp at a reasonable figure.

Following on the resignation of Mr. Dicks (mentioned in our last issue), Mr. Alfred King, of Eccles, lately with the General Electric Co., Ltd, of Manchester, and eight years with Messrs. Veritys, Ltd., of Manchester, has been appointed Messrs. G. Straus & Co.'s representative for the Midlands and Northern District; and Mr. H. Davis, of London, has been appointed for the South Coast, West of England, and Wales.

Owing to increased business, Messrs. G. H. Prescott & Co. electrical and mechanical engineers, have removed to 25, Whitby Street, West Hartlepool.

The Rhodes Electrical Manufacturing Co. inform us that on account of the great increase in business, and for the final adjustment of certain private interests, they have decided to form the present firm into a public company with limited liability. The administration of the new company will remain exclusively in the hands of the present partners, so that the business will be continued on the same lines as hitherto.

Mr. R. S. Keep has sold the electrical, stamping, pressing and export section of the business hitherto carried on as R. S. Keep and Co., at Anchor Works, Adam Street, Birmingham, to Mr. Philip Gallimore, who has long been associated with it. Mr. Gallimore will carry on the business at the Kensington Street Works, Birmingham, as the Kensington Stamping Co., Ltd.

In order to cope with increasing business, Messrs. Stegmann and Co., of Clapham Junction, have acquired additional premises, and opened new showrooms for electric light fittings to suit all styles of decoration.

Magnetic Lampholder.—The accompanying illustration shows a magnetic lampholder which is being supplied by the Electrical Trades Supply, Ltd., of Birmingham, for bayonet and screw lamps, for direct current only. The figure shows a lamp with guard and reflector. The holder contains a low resistance electro-magnet, the poles of which protrude at its bottom end. The magnet being in series with the incandescent lamp will be

strongly energised while the lamp is in circuit, and by magnetic attraction may be attached to any iron or steel object for use by machinists, boiler makers, shipbuilders, and so forth. We have received a number of picture postcards such as the company uses for correspondence purposes in connection with its ordinary every-day business.

Bankruptcy Proceedings.—At Grimsby Bankruptcy Court on March 3rd, Charles Wallace, electrical engineer, of 121, Cleethorpe Road, Grimsby, underwent his public examination The examination was adjourned.

Uralite Tests.—On Wednesday, March 2nd, the British Uralite Co., Ltd., carried out a practical test to prove the fire-resisting properties of Uralite, in Newton Street, Birmingham. Various timber structures, protected by Uralite sheets, were subjected to a fierce fire, which reached a temperature of over 2,000° F. The Exhibition was attended by over 200 gentlemen interested in fire-proof construction, and the result of the test proved conclusively that Uralite is a good resister of fire, and very suitable for many purposes in public buildings.

Switchboard Contracts.—The following contracts have been placed with Mr. Bertram Thomas, of Hulme, Manchester:—

Faversham.—Bare copper accumulator connections to switchboard for the Corporation.

Prestwich.—Switchboard and gallery for the Asylum Board.

L.C.C.—Feeder switchboard for Streatham tramway sub-station, together with "Short" circuit-breakers.

Catalogues and Lists.—The Electrical Mining Co., Ltd., of Derby, have issued a 40 pp. catalogue of their electrical machinery and accessories which are specially designed and manufactured for mining work. Numerous small illustrations show different types of machinery, with parts and accessories, for use in collieries. The prices, together with capacity, weight, and other particulars, are arranged in tabulated form. The arrangement of the list is very neat, and as so much attention is being devoted to the question of colliery working by electricity just now, it is likely to be useful.

The Govan Corporation Electricity Department has issued a 28 pp. pamphlet got up in fine style and well illustrated for the purpose of bringing before the power users of Govan, and, indeed, of the general public as well, the advantages of electricity as a driving and lighting agent. The pictures show the adaptation of the electric motor to various classes of machinery.

The Electrical Co., Ltd., have prepared a new list (No. 4B) giving descriptions and illustrations, also dimensional, capacity and other data respecting their single-phase and three-phase oil-cooled transformers.

A price list of portable accumulators, just issued, has been received from the Pfluger Accumulator Works (Sanders, Rehders and Co., of Fenchurch Street, E.C.).

Messrs. C. S. Bailey, Ltd., of Victoria Street, Bristol, are sending out a new price list of Challenger's rainproof seats for electric tramcars, such as have been used on the Bristol cars for years past, and are in service in various towns.

Messrs. J. Tylor & Sons, Ltd., of Belle Isle, King's Cross, N., have published a catalogue of their various overhead details for trolley lines. Prices and illustrations are given of ears, hangers, suspenders, section and strain insulators, frogs, trolley heads and so on.

Various lists of motor-car parts and accessories have been sent to us; by Messrs. Smith, Parfrey & Co. Ltd., of Hammersmith, motor-wheels, axles, springs, lamps, stamped forgings, and so forth.

Messrs. Hodgson, Wright & Wood, of Halifax, have issued a new price list giving net trade prices, weights, and other particulars of their S.E. type and shunt-wound motors. We understand that the list notifies large reductions in prices.

A leaflet has been received from the Brush Electrical Engineering Co., showing their "Brushmobile," a 5-h.p. petrol runabout and touring car, which has speeds up to 25 miles an hour and costs £140.

The Battersea Polytechnic authorities have issued an interesting brochure telling in the course of 100 pages, of the work that has been done at that Institute during the 10 years 1894—1904. Many illustrations of the different departments are given, also photographs of the principal and staff.

Messrs. Falk, Stadelmann & Co., Ltd., have just issued a new catalogue of electrical fixtures. Since the firm's entrance to the electrical trade, it has made great progress. It is little over a year ago since their first catalogue of electrical fixtures appeared, and the present one which we have before us is an amended and extended edition. In the opening pages we note a new feature in the form of hints for the selection of fittings most suited for particular surroundings. The contractor will find the catalogue (about 170 pp.) useful to place before customers, for, by the removal of a single perforated page, all reference to Messrs. F. S. & Co. is removed. Indeed, we understand that the firm sometimes prints in the contractor's name instead of its own. The fixtures, which are illustrated, have been carefully classified, and there is also a numerical and title index. Special mention may be made of the series of cut-crystal fittings introduced, as these form, in their application to electric lighting, an extremely effective means of illumination, apart from their decorative appearance. In harmony with the prevailing style of decoration is the range of both brackets and suspensions in the "art nouveau" school. Much latitude is given to clients in the selection of finishes offered, the majority of the fittings being supplied in antique finishes, such as silver and copper oxides, antique brass, &c. The section devoted to bronzes has had its range considerably increased, and the modelling is good. In addition are illustrated several table decorations in art pewter and porcelain.

Messrs. W. H. Bailey & Co., Ltd., have issued a neat pocket pamphlet giving directions for fixing and using their "Full-Bore" reducing valves.

The Consolidated Pneumatic Tool Co, Ltd., of Bridge Street, Westminster, have published an illustrated catalogue of their pneumatic drills, riveters, hammers, tube cutters, picks, hoists, and various other tools. Among the illustrations are a number which admirably show the application of the tools in the performance of many kinds of work.

From the Edison & Swan United Electric Light Co., Ltd., we have received two new catalogues, namely, Section II. (ship, factory and mine fittings), and Section VI. (artistic electric light fittings). These catalogues have a distinctive design on the cover which is of rough art paper, in blue and brown respectively. Catalogue Section II. is devoted exclusively to a variety of electric light fittings of the watertight order, and should form a handy list for buyers of these fittings, which are made at Ponder's End. Section VI. comprises 96 pages of fittings of all sorts, ranging from the smallest accessories and pendants to large and elaborate electroliers, standards and lanterns; some of the designs are very beautiful and special prominence has been given to the "Art Nouveau," which, contrary to the statement made in many quarters, shows no signs of dying yet, to judge from the demand. It is, of course, impossible to describe these fittings. Contractors can obtain a copy of the catalogue, and visit the "Ediswan" showrooms where many additional designs (not listed) are on view. Several supplementary pages have been issued in the form of leaflets, which were too late for insertion in the catalogue. The "Ediswan" Co. are printing all their catalogues on art paper.

A circular relating to type No. 84 distributing fuseboards (in watertight cast-iron cases) has been issued by Messrs. Ernest F. Moy, Ltd., of Camden Town.

May-Oatway Fire Installations.—The May-Oatway Fire Appliances, Ltd., of Glasgow, have placed the installation of their system for the premises of T. C. & E. C. Jack, S. Henderson and Sons, and the Edinburgh Laundry Co. respectively, with Messrs. Wm. Douglas, Ltd.; that for the premises of Mr. D. M. Brown with Messrs. Jas. Maxwell & Son; for the Great North of Scotland Railway with Messrs. Pratt & Keith; for Fleming Reid and Co., of Greenock, and the Theatre Royal, Edinburgh, with the National Telephone Co.; and for the Lyceum Theatre, Edinburgh, with Wm. Douglas, Ltd. The May-Oatway Syndicate has a long list of installations in hand at the moment, including:—Midland Railway Co., passenger station, goods sheds, &c., Heysham; London County Council, Colney Hatch Asylum; Lyceum Theatre and Theatre Royal, Edinburgh; Brown and Polson's Works, Paisley; James Templeton & Co., various warehouses and mills; J. & B. Stevenson, bakeries; and 18 other warehouses and bonded stores.

LIGHTING AND POWER NOTES.

Belfast.—The Harbour Board has applied to the B.C. for a supply of energy for working its new Dock machinery, but owing to the large supply of power necessary and the short time the plant would be in operation, the Council has decided that it would be unremunerative.

Belgium.—The municipal authorities of Marcinelle (Hainaut) have placed a contract for the erection of an electric generating station in the town.

Bexhill.—The T.C. has applied to the L.G.B. for a loan of £3,000 for E.L. purposes. Of this £500 is for additional machinery, £1,100 for mains, £400 for house services, £250 for public lighting, £365 for meters, and £671 for amount overspent on a previous loan.

The Council has agreed to supply energy to the Kursaal for 400 additional lamps, at 4d. per unit.

Bradford.—The third 2,000-h.p. engine, which has been installed at the Corporation electricity works, Valley Road, was started by the chairman of the Electricity Committee (Mr. G. H. Robinson) on the 4th inst. The engine is of the compound vertical Corliss type, running at 85 r.p.m. The cylinders are 31 in. and 60 in., with a stroke of 3 ft. 6 in. The working pressure is 160 lbs. per sq. in. The generator, which has been built by the British Westinghouse Co., has a capacity of 1,000 kw., and is arranged for supplying energy either for lighting or traction purposes.

The Corporation Electricity Committee recommends the Council to expend £8,826 on extensions to the Valley Road generating station, and £9,447 on cables required for general extensions.

Bristol.—The City Council has considered what may be termed a final report on the switchboard fire at the Temple Back station of the Corporation in December last. Alderman Pearson, who moved the adoption of the report, explained that the committee had not been able to say definitely how the fire originated, but three theories were put forward by the electrical engineer, Mr. Faraday Proctor, and the Council might take it that their order represented, in the engineer's mind, the probability of the three conjectures. The three suggested causes were:—

1. By static discharge from the metal work of the board charged at high pressure, over the surface of the insulators and slate to earth, or, in other words, to the other pole of the board, in which case it is further possible that this may have been in a measure caused by an invisible crack in one of the insulators.

2. By the breakdown of a cable receiver, or, in other words, what may be termed the joint box wherein the cables from the machines or the mains are jointed up to the switchboard.

3. By the abnormal action of the machine fuses, the blowing of the fuse causing an arc, breaking the porcelain pot filled with oil in which the fuse is placed.

The engineer's explanation also contained the following passages:—"The fuses were examined by the engineer in charge just a few minutes before the accident, and their temperature was quite normal. It is very certain, however, than when once the fault commenced, the whole of the cause of the spreading of the trouble was attributable to the oil in the fuseholders.

The fault was very much augmented by the fact that it was impossible to get the Avonbank supply cut off till after the lapse of a few minutes, as all our private telephones were rendered useless by induction on the wires, and owing to the great number of calls from consumers we were unable to immediately get into telephonic communication over the National Telephone Co.'s system. It was, therefore, not until the load at Avonbank became very excessive that they shut down the supply at that station.

Apart from the oil, there is a small amount of wood on the oldest portion of the switchboard floor, which contributed somewhat to the fire. All portions of the flooring, excepting that first installed, were formed of iron chequer plating covered with linoleum, and this withstood the test perfectly, the linoleum within a few feet of the place where the most extreme heat occurred being quite intact even at the present moment.

The window frames are of teak, and they were considerably charred, but these in themselves did not contribute largely to the trouble.

In the roof the slates are laid upon match-boarding, and this formed one of the most serious features, as the fire reaching this spread rapidly along a considerable length of the engine room, and necessitated the use of a great amount of water in the extinguishing of the flames, this water doing a considerable amount of temporary damage to the electrical machinery.

The cables contributed largely to the flames, although they were all encased in lead and further protected with steel armouring. The steel armouring, however, is served over with impregnated jute, and this getting soaked with the oil was of course very imflammable.

Alderman Pearson, in continued explanation, said the Committee, while not able to state the initial cause of the outbreak, had satisfied themselves it was not owing to the negligence of the engineer or any member of his staff. The insurance companies had treated them very fairly, and £8,225 had been received from them. An abnormal expenditure of about £1,000, to keep the supply going, would be drawn from their reserve. The accident undoubtedly had some effect in destroying public confidence in lighting. Their power load, however, in which there was practically no interruption, had increased.

Burnley.—It is estimated that the Corporation electricity undertaking will yield a profit of £4,000, and it is proposed to make an all round reduction in prices for energy.

Carnarvon.—At a meeting of the T.C. on 1st inst., a statement of claim for alleged breach of contract lodged against the Corporation by the National Electric Wiring Co. was read. It was decided to proceed with the company's scheme, and to apply to the L.G.B. to reopen the inquiry of September 2nd last.

Cheltenham.—A L.G.B. inquiry was held recently into the application of the T.C. for a loan of £4,132 for E.L. purposes, the items being asfollows:—Extensions to plant, £724; extensions to mains, £1,336; extensions to street lighting, £18; house services, £1,700; contingencies, £222. There was some opposition.

Crediton.—The U.D.C. has decided to forego the right to purchase the proposed E.L. undertaking at the end of 14 years, and has agreed to a term of 21 years. The Council, however, insists on the cables being laid underground.

Darlington.—The T.C. has reduced the price of energy for lighting by ½d. per unit, and for power purposes to 2d. per unit for 2,000 units per annum, and 1½d. afterwards, instead of 5,000 at 2d., and 1½d. afterwards.

Dartford.—The refuse destructor, which was recently inaugurated, is of the Meldrum two-grate regenerate top-feed type with a capacity of 30 tons per day, and the steam, generated in a 30-ft. Lancashire boiler, is used for electricity and pumping purposes. The work has been carried out under the supervision of Messrs. Hawtayne & Zeden, and has cost the U.D.C. about £8,300. The accessories comprise Sugden superheater, Green economiser, Hall pump, &c.

Dorking.—The U.D.C. has approved of an extension of mains, as drawn up by Mr. Trentham, at an estimated cost of £2,177.

Exeter.—The Corporation E.L. Committee has fixed the charges for energy from June 30th, as follows:—Private lighting, 5d. per unit; power and heating, and street lighting, 2½d. Meter rents are to be reduced one-half.

Falmouth.—The T.C. has sealed the transfer and agreement with Messrs. Crompton & Co. and the Electric Supply Corporation for carrying out the electric lighting scheme. Messrs. Crompton undertook to complete a supply within a total period of 2½ years from the date of the prov. order, and agreed to erect a refuse destructor and to destroy refuse at 9d. a ton, the Council to collect and deliver the refuse, the company paying £50 a year towards the expense of collecting.

Germany.—The municipal electricity works at Altona is to be enlarged at an estimated cost of £26,300.

Gillingham (Kent).—The T.C. has resolved to adopt the suggestion of its consulting engineers to meet the requirements of the Admiralty for a continuous current supply to the R.N. Hospital, and install three 50-KW. motor-generators at an estimated cost of £700, The T.C. estimate a considerable income from this contract.

Gorton.—A canvass has recently been made of the district to ascertain what demand there might be for electricity, and the result having been unsatisfactory, the U.D.C. has resolved to offer the Manchester Corporation a lease of its prov. order for a period of not less than 18 and not more than 21 years.

Halifax.—A rebate of ½d. per unit in the charge for energy to the tramways has been made by the T.C. for the year ending with the present month.

Hastings.—The accounts of the E.L. undertaking show a gross profit for the year of £7,873, and a net deficiency of £951.

Hemsworth.—A local company is being formed, with a capital of £6,000, for the purpose of establishing electricity works.

H.M. Dockyards.—It is stated that plans and estimates have been prepared for introducing electric light, and that a commencement of the work will be made during the coming financial year.

Irvine.—The Town Council has decided to submit the correspondence of the various companies which had offered to take up and work the Corporation E.L. order, to Messrs. Kirkland and Capper, and ask their terms for acting as engineers to the scheme.

Katanning (W.A.).—A public electric lighting supply has just been inaugurated in the town, the centre of the agricultural district of the State, a small plant having just been installed in a flour mill belonging to Messrs. F. & C. Piesse, for lighting the mill and distributing energy through the streets of the township. The plant comprises a Babcock & Wilcox boiler with superheater, and a Clayton & Shuttleworth horizontal compound engine, driving by belt, a four-pole dynamo of the G.E.C. Witton make, giving 40 KW. at 220 volts. The contractors for the entire plant were Messrs. J. Barre, Johnston & Co., of Perth, W.A.

Leeds.—The City Council has resolved to substitute electricity for gas in the lighting of all tramways routes within a mile of the junction of Boar Lane and Briggate.

Leek.—The U.D.C. have applied to the L.G.B. for a loan of £600 for electric light main extensions.

The advisability of adopting a free wiring system is under consideration.

Leith.—The T.C. has resolved to apply to the Secretary for Scotland for consent to borrow a further sum of £25,000 in connection with the electric lighting undertaking. It was stated that under the Secretary for Scotland's letter of July 25th, 1901, there was power to borrow £14,000, but in view of prospective expenditure after May 15th next, it was thought advisable that sanction should be asked for the borrowing of an additional £25,000—£12,000 for plant, £8,000 for new buildings, and £5,000 for underground works.

Llangollen.—The U.D.C. has resolved to transfer its E.L. order to the Llangollen Electric Power and Lighting Co.

London.—L.C.C.—The Highways Committee announced that the Shoreditch B.C. had applied for consent to an alteration of the standard pressure of supply, 150 volts, to one of 240 volts, with 480 volts between the outer conductors. Public notice of the application had been given, and no objections had been received from consumers. On the recommendation of the Committee, the Council sanctioned the alteration subject to certain conditions.

The Council decided to approve plans submitted on behalf of the Stepney B.C. for the erection of additions to the generating station in Osborne Street, Whitechapel.

HACKNEY.—The B.C. intends to apply to the L.C.C. for a loan of £26,000 for additional electrical plant, &c.

WESTMINSTER.—The Works Committee has considered a report from the engineer referring to a new type of globe for the arc lamps in the St. James's district, which would allow a better diffusion of light than the existing globes permit. The St. James's and Pall Mall Electric Light Co. offer to substitute less opalescent globes, including the necessary fitting and painting of canopies, at £1 12s. per lamp, or a total of £96 for the 60 public lamps lighted by them, and this offer has been accepted.

POPLAR.—The Electricity Committee of the B.C. has reported that following upon the report on extensions to generating plant adopted by the Council on 25th ult., the engineer had submitted estimates for other parts of the work, necessary for the scheme:—Sub-station plant £17,150 made up thus: two 250-KW. asynchronous motor-generators, £3,500; three 500-KW. synchronous motor-generators, £10,500; one 50-KW. battery for six hours, £1,500; one 50-KW. ditto removed, £300; switchgear, £750; contingencies, £600; mains, £20,250, made up thus: cables, £2,275; laying, jointing, &c., £17,375; contingencies, £600; buildings, &c., £5,600. The whole of the plant is required by the week ending September 17th. The Committee recommends that the scheme should be proceeded with in its entirety.

The engineer further proposed that the price of energy for power should not be more than 1½d. per unit, and submitted a statement showing that in 1902-3 the maximum load demanded of the works was 912 KW. (December 12th, 1902), the capital cost to provide for this maximum demand was £187,539 16s. 2d., and the average daily output in units during the year was 5,403. During the 12 months under review the daily standing charges were £31 2s. 6d., and the running charges (·66d. per unit) £14 17s. 2d., or a total of 2·04d. per unit generated. He believed that with reduction of price, liberal advertising and energetic canvassing, a 60 per cent. load factor could be attained, in which case the cost of production would be reduced to 1·23d. per unit generated. Further, if the arc lamps were run the whole of the night instead of being switched off at 1 a.m., the cost of energy could be reduced, the same as for motive power to 1½d. per unit, but plus maintenance and capital charges. Under the existing system the public lighting charges for the coming Midsummer quarter would be £9,970 0s. 8d. Under the scheme as proposed they would be £9,077·16s. 5d. The engineer estimated that provided the ratio of units sold under the foregoing proposals for motive power and public lighting be increased from 50, as at present, to 80 per cent., the net result would be that the £4,284 profit shown on the undertaking last year would be raised to £11,458. He anticipated an immediate accession of at least 500 KW. from the reduction in price. The Committee approved of the proposals; the reductions to take place on the 1st. prox.

MARYLEBONE.—At the meeting of the B.C. on the 3rd inst. it was decided that a Special Committee of all the members of the Council should be appointed to consider the Bill which the Council is promoting in Parliament and the several suggested amendments thereof. It was stated that if Parliament rejected the Bill the payments made would involve a rate of 1s. 6d. in the £ on the present rateable value of the borough. A motion that the engagement of Mr. Arthur Wright, the electrical expert, be determined, was lost by an overwhelming majority, and the recommendation in the Electrical Supply Committee's report, authorising them to secure an amendment to the Bill conferring power on the Council to enter into an agreement with a company to carry on the undertaking either temporarily or permanently, and that the common seal of the Council be affixed to the necessary petition to the House of Commons was agreed to.

Ludlow.—The T.C. has been informed by the L.G.B. that in regard to its application to borrow £8,250 for purposes of electric lighting, the scheme was in many respects incomplete and unsatisfactory, and that, if it were properly revised, the estimate would be considerably increased.

Melksham.—The Southern District Electricity Corporation has offered to establish electricity works in the town, under an agreement with the U.D.C., and the matter is being considered by a committee.

Neath.—The T.C. has resolved to apply for sanction, to a loan of £5,000 for the purpose of carrying out its E.L. Order, and to invite tenders for laying mains.

Morley.—The T.C. has decided to adopt the engineer's recommendation to again reduce the price of energy for lighting from 4½d., less 5 per cent., to 4d., less a varying discount of 2½ per cent. to 25 per cent. In addition to the above, new consumers will, during the months of April, May, June and July, be supplied with energy free of cost.

Newport (Mon.).—Mr. Ralph Nance, of Cardiff, has recently installed a private plant at the residence of Mr. D. A. Thomas, M.P., at Llanwern Park. It consists of a Cundall (Shipley) oil engine coupled to a Webster (Bradford) dynamo, and a battery of the "A.B.P." Accumulator Co.'s cells. The water supply is by an electric pump fixed about half a mile distant. The engine when not being used for generating purposes is utilised for driving various agricultural machines. The contractor for the building work was Mr. W. T. Case, of Newport.

Two electric ventilating fans are to be placed in the police-court at a cost of, probably, £100.

Perth.—The Town Council have under consideration the question of improving the lighting of the streets. It is proposed to displace the electric incandescent lamps by arc lamps or incandescent gas lamps. Reports, with comparative cost, have been submitted by the gas and electric engineers, for the consideration of the Council.

St. Helens.—The T.C. has decided to apply to the L.G.B. for a loan of £4,650 for E.L. purposes.

Shanghai.—A meeting of the ratepayers was held in January last, and a resolution passed protesting against the arbitrariness of the Municipal Council in regard to its electric lighting, and it was decided by a large majority that the Council exceeded its rights of legitimate trading with electric fittings, &c.

Sidcup.—At the recent public meeting of the ratepayers the following resolutions were submitted and rejected:—To proceed with the E.L. Order obtained by the late P.C.; to enter into a contract with the Bexley U.D.C. for a supply of energy in bulk; to enter into a contract with the Woolwich B.C. for a supply of energy in bulk; to consider proposals for erecting an electric power and lighting station within the U.D. of Foots Cray. A poll of the parish was demanded, and this has now taken place, the result being a majority against the Council of 509.

Stockton-on-Tees.—The T.C. has agreed to supply energy to the Stockton Forge at 1d. per unit on condition that the company takes a minimum of £180 worth per annum for five years.

Stretford.—The chairman of the Stretford Electricity Committee made a statement at the last meeting of the Urban District Council with regard to the financial position of the undertaking. The cost of production for four months, he said, was at the rate of 1·05d. per unit. The income was £1,563, and the expenditure £2,020, leaving a deficit of £457. These figures include a charge for repayment of loan and interest during construction, which, in any private undertaking would be charged to capital. If revenue was credited with its proportion of loan repayment for the period during which the station had been working, a small surplus would be shown. The engineer's estimate for the year ending March 31st, 1905, showed an expenditure of £6,021, and a revenue of £7,310, leaving a profit of £1,289. There will be no charge on the rates in connection with the undertaking, and that he expected they would soon be able to reduce the price of energy for private use.

Trowbridge.—The T.C. has resolved to assent to the application of the Western Electric Distributing Corporation for a prov. order to light the district, and has entered into an agreement whereby the Council receives £400 for the withdrawal of its opposition, a royalty of £25 per annum, and special terms for street lighting.

Tonbridge.—The U.D.C. has decided to contract with private firms for the wiring of consumers' premises on the hire-purchase system.

Walsall.—The Board of Guardians has decided to have the E.L. installed in the new workhouse buildings.

Watford.—The R.D.C. is opposing the application of the U.D.C. for a prov. order for electric lighting, and in view of this it has been been decided to ask the B. of T. to dispense with the consent of the R.D.C.

Whickham.—The B. of T. has granted an order enabling the U.D.C. to transfer its prov. order to the Durham Electrical Power Distribution Co.

Willesden.—At the last meeting of the U.D.C., the solicitor reported it would be necessary to seal an authority authorising him to use the name of the Council as relators in the proceedings to be instituted against the Metropolitan Electric Supply Co. restraining them from supplying electricity to any person or company in the district of Willesden. It was resolved to affix the seal of the Council to the document submitted. An offer from the Prudential Assurance Co. to advance £14,600 at 3½ per cent. for electricity extensions was accepted. The electrical engineer was asked to report upon the question of a flat-rate supply and a tariff for short-hour consumers. Extensions of distributing mains to cost £488 17s. were sanctioned.

TRAMWAY AND RAILWAY NOTES.

Auckland.—The R.D.C. has granted the application of the United Kingdom Electrical Syndicate for a renewal of the Council's sanction to a proposed prov. order for powers to construct electric tramways, on the company entering into a bond of £500 to have the work completed at a certain date, and to pay the Council £5 per mile of line in the district per annum.

Birmingham.—At the last meeting of the Aston Manor Borough Council, it was stated that the reason for delay in through connection between Birmingham and Aston was the delay in delivery of some special castings of points and crossings for the permanent way at Aston Cross. Mr. Green, the tramways engineer of the Aston Council, has reported that there are hopes of the L. & N. W. Railway Co., agreeing to the proposed replacing of the present bridge at Aston with a girder bridge. This will permit of a double track, and there is also a proposal to run the trams right out through Erdington. The Small Heath—Yardley extension of the City of Birmingham Trams Co. is now ready for traffic, and awaits B of T. inspection. It is electrically equipped, and there are eight cars ready for use. The Corporation's first section, Steelhouse Lane to Aston Cross, is paying expenses, it is stated, drawing an average of £300 per week. The B.E.T. Co. propose using the four-wheeled truck type of car on the Bristol Road route more than they have done so far, in place of the eight-wheeled bogie type.

Blackpool.—Some discussion took place at the last meeting of the T.C. with regard to the prospects of the tramway undertaking. It was said that the Committee, by a readjustment of fares, were "trying to make people pay for past blunders and mismanagement." Nearly a quarter of a million of capital has been invested in the tramways, which the ratepayers expected would yield a fair return towards an abatement of the rates, but critics allege that they will have to face a loss on the current year's working. Replying to these criticisms, Mr. Alderman Brodie said that, up to July last, the traffic was satisfactory, but, "instead of having 10 fine weeks during the season, they had not so much as 10 fine days." Consequently, the tramway receipts suffered considerably. The working expenses per week, he said, the year round, were £800, but the receipts at present do not exceed £250 a week. A motion that the proposed alteration in the fares should not take effect until July 1st, was rejected.

Brighton.—The Tramways Committee recently instructed the engineer to report on the advisability of connecting the Queen's Park Road line with the Aquarium terminus by way of a short line along the Marine Parade on the Sea Front. When this came before the Council for confirmation on March 3rd, it involved a heated discussion, as it was the first official proposition for tramways to be laid along the Sea Front. From what was said it was evident that everyone acknowledges that tramways will eventually be laid along the Front, but many thought that this short line would be the thin edge of the wedge for extending them later on. The proposition was eventually thrown out by 31 votes to 9, so that for the time being, at any rate, the question is shelved.

Bradford—Shipley.—The Tramways Committee of the T.C. reports that terms have been arranged for the acquisition of the electric tramways at Shipley from Messrs. White & Co. The price to be paid by Shipley U.D.C. is £32,751, and during the tenure of the lease Bradford will pay the Council 6 per cent. on this sum, and will also pay Messrs. White & Co. £7,500 for cars, and to the U.D.C. £100 a year per mile of single line for maintenance and repairs, and 4½ per cent. interest on £5,000 spent on street improvements. Shipley will supply energy at 1½d. per unit.

Burnley—Nelson.—The Nelson T.C. has resolved to grant Burnley Corporation a lease of the tramways for seven years at an annual rental of £830. Nelson is to repair and maintain the permanent way and overhead equipment, Burnley paying the actual cost, plus 5 per cent. for supervision. Nelson will also supply energy at 2d. per unit.

Burton-upon-Trent.—The half-yearly report respecting the Corporation tramways gives the following results:—

Total traffic receipts, advertising, &c., £9,311 14s. 1d.
Total car-miles, 212,562, or a mean of 8,174·3 per week.
Total passengers carried, 2,019,087, or a mean of 77,657·18 per week.
Population of town, 51,000.
Population carried at the rate of 79·18 times per annum.
Total parcels carried, 7,646, or a mean of 294·07 per week.
Traffic receipts per car-mile, 10·28d.
Number of passengers per car-mile, 9·46.
Receipts per passenger per car-mile, 1·14d.
Grand total receipts per car-mile, 10·48d.
Mean cost of power per car-mile, 1·91d.

For the first five weeks there was no Sunday running, which would have increased the receipts by about £300.

Bury.—An agreement between the Bury, Rochdale, &c., Tramways Co. and the local authorities of Bury and the district for the working of the tramway system has been signed. The lines are to be managed by a joint committee of the local authorities and the directors of the company, and the authorities are to pay the company £2,400 as from July 21st to January 31st last, and from the latter date until the completion of the purchase the payment will be at the rate of £5,300 a year. Working expenses will be provided for out of receipts; any loss to be borne by the company; any surplus to go to the local authorities. The work of electrifying the lines has been begun in Bury, and it is to be expedited as far as possible. The last section, it is expected, will be finished by the middle of September. The Bury Corporation wants a through ser-

vice to Heywood, and are considering the possibilities of its being effected without loss. As regards the Bury to Radcliffe service, work will be commenced upon the permanent way as soon as the provisional order has been obtained from the Board of Trade.

Bournemouth.—After a protracted discussion, the Council on March 1st resolved to pay Mr. Lacey £750 as remuneration for services in connection with the tramways scheme, the amount to be paid from capital account, also to increase his salary to £800, rising by annual increments of £50 to £1,000 per annum.

Derby.—At a recent special meeting of the Town Council, Ald. Duesbury, J.P., chairman of the Tramways Committee, said it would be in the memory of the Council that there had been a considerable amount of talk about a contract for Belgian rails being entered into, and the Committee were blamed for it. As a matter of fact, the Committee had never entered into a contract for Belgian rails. They let the contract for the construction of the line to Messrs. J. G. White & Co., and a very stiff test was imposed for the rails. They accepted the tender of the Belgian firm, but they had experienced considerable difficulty in getting the contractors to supply rails according to specification, and they had been unable to get them supplied in proper time. As a consequence, they had broken their contract with the Belgian firm and entered into one with the North-Eastern Steel Co., Middlesbrough, to supply the whole of the rails, with the exception of the 250 tons that had been delivered. Of the new contract, 300 tons had been made and tested, and would be in Derby that week, and the whole of the quantity required would be delivered within one month. The alteration would not entail any extra cost, as the North-Eastern Steel Co. were supplying them at the same rate as the Belgian firm.

Glasgow.—Something like a deadlock has taken place between the Caledonian Railway Co. and the Tramways Committee of the T.C. over the proposed extensions to Thornliebank and Giffnock. Both the tramways and electricity departments of the Corporation are supplied with water for condensing purposes from the Forth and Clyde Canal, which is the property of the railway company. On December 15th last the Corporation received a letter from the company stating that this privilege would cease at the expiry of three months. Since then negotiations have been proceeding between the Corporation and the company. The Distillers' Co. are also implicated in the negotiations, and an agreement was entered into whereby the Distillers' Co. had agreed to allow the Tramways Committee to take the water from the Canal provided they got a supply of Loch Katrine water free of charge to the extent of £400 per annum. It was agreed to recommend the Corporation to approve of this arrangement in the expectation, and provided that this would lead to an amicable settlement between the Corporation and the Caledonian Railway Co. At a meeting of the Corporation, however, on Thursday, the 3rd inst., a letter was received from the solicitor of the Caledonian Railway Co. breaking off the negotiations. The letter stated that it had been explained to Mr. Young, the general manager of the tramways, that the proposed extensions of the Corporation tramways to Barrhead and Whitecraigs would injure the company, and that the company regarded such extensions as hostile, and consequently were not prepared to enter into any amicable arrangement as to the canal water supply and other matters, unless the Corporation were prepared to come to a satisfactory arrangement with the company as to the proposed tramway extensions. The modification of the extensions was not considered by the company as satisfactory, and could not be agreed to, as it would still leave the circular route *vid* Thornliebank and Giffnock, which, in the view of the company, would establish a most unfair and injurious competition with the company's railways. The Corporation, however, intimated that they could not agree to the matter of the proposed extensions being brought forward in connection with the matter of the canal supply and the other matters which were the subject of negotiation, and it thus appeared that there was no basis of an amicable settlement between the Corporation and the company, and in these circumstances there was evidently no result to be gained in prolonging the correspondence.

The T.C. has adopted a new covering for the top of their cars for use in wet and stormy weather.

L.C.C. Shallow Tramways.—The members of the Civil and Mechanical Engineers Society, on the 19th ult., visited the shallow tramway under Kingsway, which the L.C.C. is constructing. The subway will pass under the western arm of Aldwych, north under Kingsway, and then under Holborn to Southampton Street, where it will come to the surface at a slope so as to join up with the existing tramway lines that concentrate at Theobald's Road. On each side of the tramway tunnel there will be two subways, which will accommodate gas and water pipes, electric mains, &c. Below each of these side tunnels there will be a sewer. Near the site of the old Olympic Theatre, there will be a station, which will be reached by staircases, but the whole scheme includes a continuation of the tunnel as far as the Embankment. The width of the tunnel will be 20 ft., and the height from the crown of the arch to rail level 14 ft. The pipe subways on each side of the main tunnel will be 12 ft., whilst the egg-shaped sewers beneath will be 2 ft. 8 in. by 4 ft. 6 in. The depth of the tunnel beneath the surface varies from 6 ft. to 14 ft., the greater depth being where the work passes under Holborn and the Strand. At these places the main tunnel will be divided into two smaller tunnels for convenience of construction. Special precautions have been taken to preserve the brickwork from decay by damp, there being a lining of asphalte ¾ in. or more thick. The electric cars will work on the conduit system. The work has, so far, been carried out on the "cut and cover" system. In passing under the Strand and Holborn, the method of proceeding will be by the Greathead shield, which will enable the excavation to be burrowed out without disturbing the surface, so that there will be no stopping of the traffic of these important thoroughfares. The tunnel is lined with tiles or enamelled bricks, and it is, we believe, proposed to illuminate it throughout by electric light, although it will only be available for passenger traffic by the electric cars.

Lincoln.—The Electricity Works Committee recommended the Council in Committee to adopt a certain system of electric traction for the tramways instead of the overhead system. A meeting of the Council in Committee is to be held to consider the question.

Liverpool—Southport Electric Railway.—A record run was made on the Southport—Liverpool electric railway on Sunday, March 6th, a large number of officials being on board, including Mr. Aspinall, general manager, Col. Yorke and Mr. Trotter, of the Board of Trade, and a number of officials of Messrs. Dick, Kerr & Co., Ltd. The trial trip was from Liverpool to Southport and back again. The journey from Liverpool Exchange station to Southport, Chapel Street, was made in 20 minutes—from 3.50 to 4.10. The run was accomplished without a stop, and was highly satisfactory. The new service is expected to be inaugurated on the 22nd inst.

Newport (Mon.).—The Electricity and Tramways Committee recently reported that the cost of keeping the present cars in repair had cost much more than they had expected, and was increasing week by week.

Mr. H. F. Parshall, the consulting engineer, estimated the cost of the equipment of the tramways, car-sheds, and generating station at £130,640, or, alternatively, £137,000, but it is stated that the actual cost has been £125,183.

New South Wales.—The report of the Commissioners on the New South Wales State Railways for the quarter ended December 31st, says that the tramways show increased earnings of £16,716, while the expenditure also increased by £11,727, the result being a net improvement of £4,989.

New York City.—An order for 200 steel cars for use on the subway system has been placed by the Interborough Rapid Transit Co. with the American Car and Foundry Co. This is in addition to an order already completed for 300 copper sheathed cars, and the two kinds will be compared with each other in practice with a view of deciding which is the better means of guarding against fire dangers. The dimensions of the steel cars are :—Length over body corner posts, 41 ft. ½ in.; length over platforms, 51 ft. 2 in.; width over sheathing, 8 ft. 7 in.; width over eaves of lower deck, 8 ft. 9¼ in.; width over window sills, 9 ft. ½ in.; width over platform floor, 8 ft. 10 in.; height from rail to roof, 12 ft.; from platform to under side of sill, 7 ft. 1 in. The electrical equipment will be a couple of 200-H.P. motors mounted on one of the trucks. It is claimed that in the event of a short-circuit, the steel car will "ground" the escaping current, and all the fuses will be opened, making the third rail dead in that section.

Ottawa.—The Street Railway Co. is having to contend with a great fall of snow this winter, but has, it is stated, so far succeeded in keeping its tracks open for traffic. Nine electric sweepers, three wing ploughs and 13 others, are used by the company, and it is estimated that about 30,000 loads of snow have been carted away this season. One of the wing ploughs is of 200 H.P., and it is stated that the company has spent $75,000 in snow-clearing machinery. The storms this winter have cost the company about $15,000.

Perth.—The T.C., through one of its representatives who recently visited Edinburgh, has had information placed before it with regard to the cost of equipping the present tramcars with petrol motors in preference to adopting the scheme for electrification. It is contended that motors could be fitted to the present cars in Perth for £400, or that alternatively, new cars, propelled by such power, and capable of accommodating 43 passengers, could be built for £500 each. The total cost to build 10 cars (the number proposed by the consulting engineer) would thus be £5,000, as compared with £80,000, the sum estimated for converting the system to electric traction. A detailed report is in course of preparation.

Stretford.—The Light Railway Commissioners have had under consideration the draft orders for the Stretford and Manchester Light Railways. The Manchester Corporation desired to ensure that these orders should provide for through working between Trafford Park and the Manchester lines, the Corporation being bound by agreement to take over the Stretford district tramways when constructed. Undertakings were given, on behalf of the West Manchester Light Railway Co., and of the Stretford Urban Council, that they would each construct their own portion of the lines, and so ensure the through working.

Wolverhampton.—Our correspondent writes :—"On Tuesday, Col. Yorke, C.E., of the B. of T., inspected the Dudley Road section of the tramways. The line extends from Snow Hill to the Fighting Cocks, where it joins the overhead system of the B.E.T. Co. It is 1¼ miles in length, and its construction cost £11,582—at least, that was the amount of the contract—exclusive of the electrical equipment. The section was commenced by Mr.

Holloway, the contractor, on November 12th last, and finished about a fortnight ago. Col. Yorke was met by the Mayor and Town Clerk of the borough, several members of the Tramways Committee, and the tramway officials. A double-deck car was run over the line, and the journey was performed without the slightest hitch. The Colonel took an opportunity of making a careful examination of the setting of the boxes and other matters, and that he was thoroughly satisfied may be gathered from the fact that at the conclusion of the inspection he told the Committee that they might commence running the cars for public traffic as soon as they liked. Subsequently Col. Yorke examined that portion of the Willenhall Road section, which is fast approaching completion. He expressed himself well satisfied with the substantial manner in which the contractor, Mr. Holloway, was carrying out this part of the work, and its electrical equipment by the Lorain Co., and he gave the representatives of the Tramway Committee to understand that he should regard the line not as an extension, but as simply a reconstruction. Under these circumstances, if, when the whole of the line was completed, the Board of Trade representative were prevented, by reason of other engagements, from coming down to make his official inspection, there would be, it was understood, no objection raised to the Committee opening the line for public traffic without delay. The Dudley Road section was opened for traffic on Wednesday morning."

TELEGRAPH AND TELEPHONE NOTES.

Brighton Telephones.—The Committee having reported that by March 1st the number of subscribers connected would reach 750, it was decided to start charging for the service, which, up to then, had been given free. When it was originally proposed not to charge until 750 subscribers were connected, the National Telephone Co. made a strong representation to the Postmaster-General that the Corporation in so doing were exceeding their rights. The Postmaster-General wrote to the town clerk saying that the Corporation had no powers to give a free service, and that the same must be discontinued. The town clerk, in reply, stated that the Corporation were only following the example of the Post Office authorities in London who gave a free service at first; since which letter, nothing more has been heard of the matter. There are at present over 800 subscribers waiting to be connected up.

Glasgow Telephones.—The general manager, in reporting upon the needed new borrowing powers, of which mention was made last week, said that the number of instruments working up to January 31st was 10,822, while the number of orders on hand still to connect, was 443, but as orders continue to be received freely there is no prospect of the amount of work to be executed being curtailed for a considerable time to come. The amount expended for capital purposes as at January 31st was £318,562 1s. 3d., part of which has been met out of revenue, in which sum is included furniture, fittings, tools, stores, and preliminary expenses, amounting altogether to £21,782 5s. 2d., leaving the sum of £296,779 16s. 1d. as having been expended on construction. Cables containing a gross number of pairs of 20,928 have been laid, of which only 12,478 pairs have been used so far, leaving 8,450 pairs still available for joining up new subscribers. The number of 3-in. pipes laid is 150. Of these, 62 have not yet been used. Taking the average capacity of a 3-in. pipe at 250 pairs, which is the lowest mimit—each pipe, if filled to its maximum, will take 312 pairs—there has been provided a surplus duct capacity for 15,500 pairs. In the switch-room, spare switchboard accommodation for 1,311 subscribers' lines also exists. The Committee recommended the Corporation to apply to the Secretary for Scotland for power to borrow an additional sum of £50,000, in order to carry on the further development of the department. The Council has approved this course.

The Application of "Gutta Gentzsch" in the Manufacture of Telegraph Cables for the Imperial Post Office of Germany.*—In No. 22 of the *Archiv für Post und Telegraphie* for the year 1902, mention was made of the experimental cables laid by the Imperial Post Office, in the insulation of which an artificial gutta-percha, produced according to the suggestion of Mr. Adolf Gentzsch, of Vienna, has been used. It is now proposed to go further into the scope of these experiments, and to record the results that have been observed so far.

First of all, it should be remarked that the Imperial Telegraph Board only decided to occupy themselves with these experiments after the usefulness and applicability of this new insulating material had been proved by the investigations of the Official Experimental Department, and by the tests and experiments carried out by the firm of Felten & Guilleaume, who had undertaken the manufacture of the artificial gutta-percha on the basis of an agreement with the inventor.

The material consists of a mixture of pure india-rubber and a sort of wax, the melting point of which is approximately that of rubber, so that a separation of the component parts does not take place with a rise in temperature.

The electrical properties of "Gutta Gentzsch" are similar to those of the natural gutta-percha; mechanically, however, the artificial gutta-percha is superior to the natural gutta-percha, in so far as the artificial material can stand a temperature of 60° C. (140° F.) without becoming soft.

An order was placed with Messrs. Felten & Guilleaume for a four-core sea cable 8·7 kilometres in length, and this was laid in the year 1902, between the Mainland and the Island of Föhr. Each core consists of seven strands of copper wire 0·6 millimetres in diameter, which are covered with "Gutta Gentzsch" to a diameter of 6 millimetres. The four cores are spirally laid up and wound round with tanned jute yarn and then protected by an armouring consisting of 14 iron wires of circular section and 5·3 millimetres diameter served with a double covering of compound. The finished diameter of the cable is about 36 millimetres, and the weight about 3,500 kilogrammes per kilometre. Each core had to fulfil the following conditions:—

Conductor resistance 9·6 ohms per kilometre at 15° C.
Minimum insulation resistance 500 megohms per kilometre.
Maximum value of capacity 0·15 microfarad per kilometre.

The following table gives a list of other "Gutta Gentzsch" cables which have since been laid by the Imperial Post Office of Germany. The method of construction and the terms and conditions of delivery were the same as those for natural gutta-percha cables of similar type:—

Description of cable.	Length.	No. of cores.	No. of strands in each core.	Diameter of strand.	Conductor resistance, per km.	Insulation resistance, per km.	Capacity, per km.	Diameter of core.
	km.			mm.	ohm.	meg-ohm.	micro-farad.	mm.
Ihrhove-Weener	0·42	7	7	0·73	6·5	650	0·22	7·0
Norden-Nordeich	5·00	4	7	0·66	7·0	500	0·24	5·2
Vinkelpolder-Nordeney	8·00	3	7	0·73	6·5	650	0·22	7·0
Do. do.	1·00	3	7	0·66	7·0	500	0·24	5·2
Cable across the River Weichsel	0·75	7	7	0·73	6·5	650	0·22	7·0
Cable across the River Ems:—								
(*a*) At Oberlangen	0·32	1	7	0·73	6·5	650	0·22	7·0
(*b*) At Halte	0·20	1	7	0·73	6·5	650	0·22	7·0

The cost of these cables was on the average 35 per cent. less than that of ordinary gutta-percha cables of the same size. The Government have thus made a saving of 20,000 marks in the 24½ kilometres of Gutta Gentzsch cables already laid.

In every case the cables, when taken over, gave better electrical results than were specified in the contract.

In laying the cables, the method of making a joint was somewhat modified as compared with that in vogue in ordinary gutta-percha cables. The joints were made partly with natural gutta-percha.

Up to the present, the cables have given every satisfaction in working, and no unfavourable reports of any kind have been received.

Telegraphic Interruptions and Repairs:—

Cables.	Interrupted.	Repaired.
Dominica-Martinique	.. May 5, 1902 ..	..
St. Lucia-Martinique	.. May 7, 1902 ..	..
Trinidad-Demerara No. 1	.. Aug. 27, 1901 ..	..
Mole St. Nicolas-Port-au-Prince	.. Dec. 16, 1903 ..	March 8
Cayenne-Pinheiro	.. Aug. 18, 1902 ..	..
New York-Hayti	.. April 18, 1903 ..	..
Anjer-Kalianda	.. Aug. 2, 1902 ..	..
Reissa-Issa (Yemen)-Camaran	.. Oct. 23, 1902 ..	..
Teurane-Amoy	.. Nov. 10, 1903 ..	..
Rome-Pera	.. Feb. 29, 1904 ..	March 3
Tarifa-Tangier	.. Jan. 18, 1904 ..	..
Oran-Tangier	.. Feb. 3, 1904 ..	..
Closed { Nagasaki-Vladivostock	.. Feb. 15, 1904 ..	..
Closed { Port Arthur-Chefu	.. Feb. 18, 1304 ..	..
St. Jacques-Haiphong	.. March 7, 1904 ..	..
Landlines.		
Seoul-Masampo	.. Feb. 13, 1904 ..	..
Seoul-Gensan	.. Feb. 13, 1904 ..	..
Anju-Ping-Yang	.. Feb. 25, 1904 ..	..
Ninguta-Vladivostock	.. March 2, 1904 ..	..

The Government Telephone System.—In the House of Commons, Mr. John Campbell asked the Postmaster-General whether he could state the sum expended on telephone instruments in connection with the new system up to date; how much of this amount had been spent on instruments manufactured in England and how much on instruments manufactured in Sweden, Antwerp and America; and whether he could give the patent number of the instruments which he was compelled to purchase from foreign firms. Lord Stanley placed the following answer on the Parliamentary paper:—"The sum expended on telephone instruments for the new system in London could not be given without a careful analysis extending over four years, and this would involve much labour and expense. The amount expended on stores of all kinds for the telephone system of the whole country during the four years is £1,328,966. Of this amount about £176,500 was spent on articles manufactured abroad; but most of this was on account of central battery switchboards and their equipment, which are patented. Telephones for the use of subscribers have had to be obtained from abroad from time to time because they could not be obtained in this country; but I am glad to say that British companies are now prepared to manufacture them, and I hope I shall be able to reduce more and more the amount spent with foreign manufacturers."

(*Continued on page* 427.)

* Translated from the *Archiv für Post und Telegraphie*, being an official publication of the German Imperial Post Office.

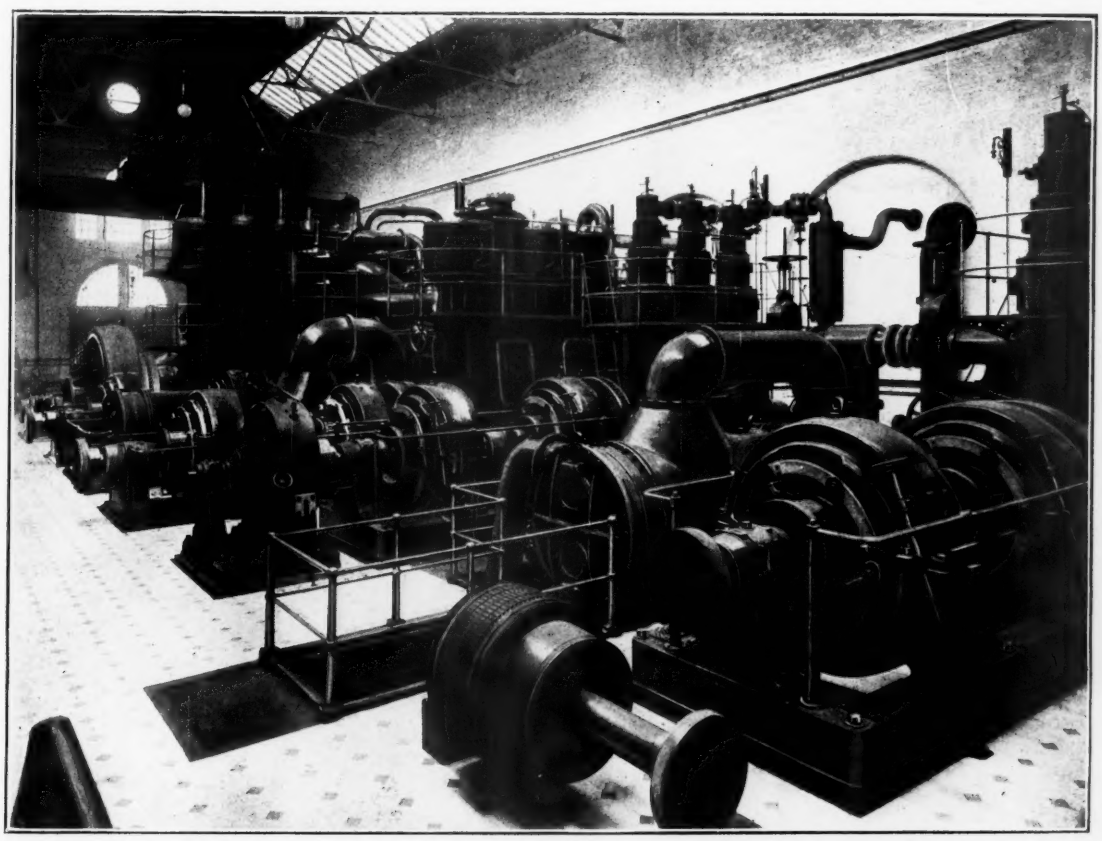
THE ELECTRICITY WORKS AND DESTRUCTOR OF THE METROPOLITAN BOROUGH OF HACKNEY.

One of the most important municipal electrical undertakings in the County of London is that which was inaugurated by the Metropolitan Borough of Hackney in November, 1901. That this is also one of the most economical in operation will appear later. The supply is given on the direct current system at 240 volts, and from the commencement flat rates of 4d. for lighting and 2d. for power have been charged for electrical energy—lower rates, we believe, than have ever before been recorded in the case of an entirely new undertaking.

The origin of the scheme dates back to past ages, a provisional order having been obtained by the Vestry in 1893. The vicissitudes through which the movement has passed, however, have been chronicled from time to time in our pages, and we will content ourselves with a very brief sketch of the preliminary steps. In 1898 Mr. Robert Hammond was consulted on the subject, and drew up a report recommending an initial outlay of £247,367. A large area was to be covered, and the ultimate length of distributing mains to be laid was 110 miles, fed at 17 points. The generating plant was to be capable of supplying 75,000 8-c.p. lamps. A sum of £22,000 was allotted to the erection of a refuse destructor in conjunction with the electricity works, capable of dealing with 38,000 tons of refuse per annum.

Tipping Platform.

Mr. Hammond's report was adopted, and he was appointed consulting electrical engineer to carry out the project. The plans and specifications were duly prepared and contracts placed, and in October, 1900, the foundation stone of the works was laid, the site selected being on the River Lea. Mr. G. A. Ogan was the chairman of the Electric Lighting Committee at that time, and by his untiring exertions on behalf of the undertaking set an example worthy of emulation by his successors. In November, 1901, the supply was commenced, and has



General View of Generating Plant.

continued without cessation, under the charge of Mr. L. L. Robinson, borough electrical engineer.

The works are situated on a site of about 5 acres in Millfields Road, Hackney, with a frontage on the River Lea, affording ample space for dealing with coal and ashes, and for extending the works when necessary. The plant at first installed was of 1,800 KW. capacity, but this has already been increased to 3,372 KW.

Coal Bunker, Electric Crane &c.

The buildings comprise an administration department facing on Millfields Road, including general offices, chief and assistant engineers' offices, board room, test room, drawing office, &c.; the destructor, the tipping-floor of which is approached by inclined roadways, past a weigh-house at the entrance to the site; destructor and coal-fired boiler-houses; engine room, battery room, stores, &c.; and a coal store. A special lay-bye has been constructed on the river frontage, capable of holding several barges, by which coal is brought to the works.

Top of Destructor Cells, showing Ventilating Duct, Shoots and Boilers.

The refuse destructor was built by Messrs. Hughes & Stirling, to the designs of Mr. J. Liversedge, of Arundel Street, W.C., and consists of 12 cells. The tipping floor, of which we give a view, is capable of accommodating six carts at once, which are unloaded into hoppers. From the latter the refuse is elevated by three bucket conveyors, rated at 10 tons per hour each, to storage bins. The conveyors are driven by motors, mounted over the top of the bins, and controlled by switchgear at the tipping platform.

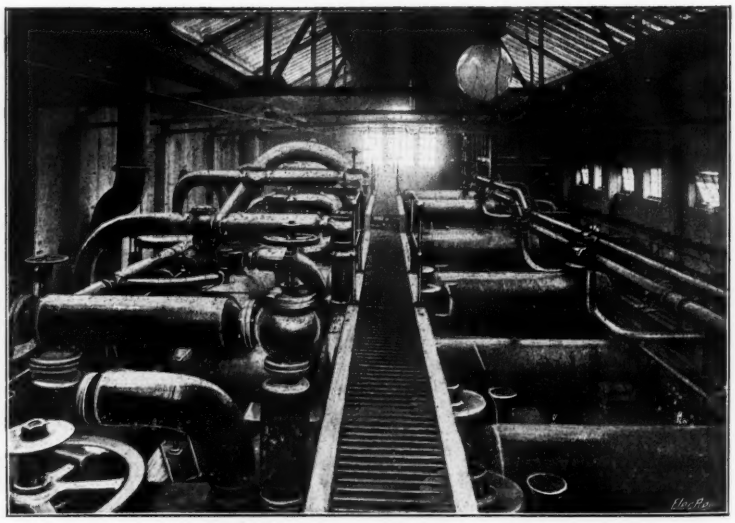
Passing on to the destructor house, we give a view taken on the top of the cells, showing the shoots and doors by means of which the refuse is admitted from the storage bins to the cells as required. The whole of each day's refuse is consumed within the 24 hours, so that there is no chance for a nuisance to arise through too prolonged storage. The refuse, which is assisted down the shoots by hand labour, falls upon flat fire-brick drying hearths at the back of the cells, whence it is pulled forward upon the fire-bars.

Ventilation is abundantly provided for by means of air ducts, with openings at intervals, in connection with the forced draught system. There are three centrifugal fans, driven by 15-H.P. Rhodes motors in an adjoining chamber, which draw the air through the ducts, and force it into the destructor cells; two fans working together are sufficient. A common combustion chamber is provided for each group of four cells, whence the hot gases may be led either through boilers, or through a bye-pass to the chimney, in either case traversing a whirling chamber on the way, in which dust is deposited.

Each group of four destructor cells is designed to deal with 60 tons of refuse per day, though they have destroyed a total of nearly 190 tons on occasion; the average last year was 120 tons. The destructor is shut down for 24 hours on Sundays.

The destructor is worked in conjunction with three Babcock & Wilcox boilers of the double-drum type, each having 2,852 sq. ft. of heating surface, and rated at 10,000 lbs. evaporation per hour with coal. Over each boiler there is a large cylindrical water purifier, in which the feed water is well steamed before entering the boiler; this is in addition to special treatment plant.

The steam from these boilers is fed direct into the main range running along the coal-fired boilers, there being no ring or duplicate main. As we have often urged, the latter are nowadays superfluous, as well as wasteful, luxuries.



Top of Coal-fired B. & W. Boilers.

Owing to the high temperature of the gases from the destructor, superheaters are not fitted to the boilers above-

Front View of Coal-fired B. & W. Boilers.

mentioned; the waste gases, however, pass from the boilers to a Green economiser of 288 tubes on the way to the chimney shaft. The scrapers are driven by a motor through a Renolds chain.

The coal-fired boilers are also of the Babcock & Wilcox type; there are four having a heating surface of 2,852 sq. ft. each, and evaporating 10,000 lbs. of water per hour; they are fitted with superheaters of the same firm's make, having a surface of 389 sq. ft.

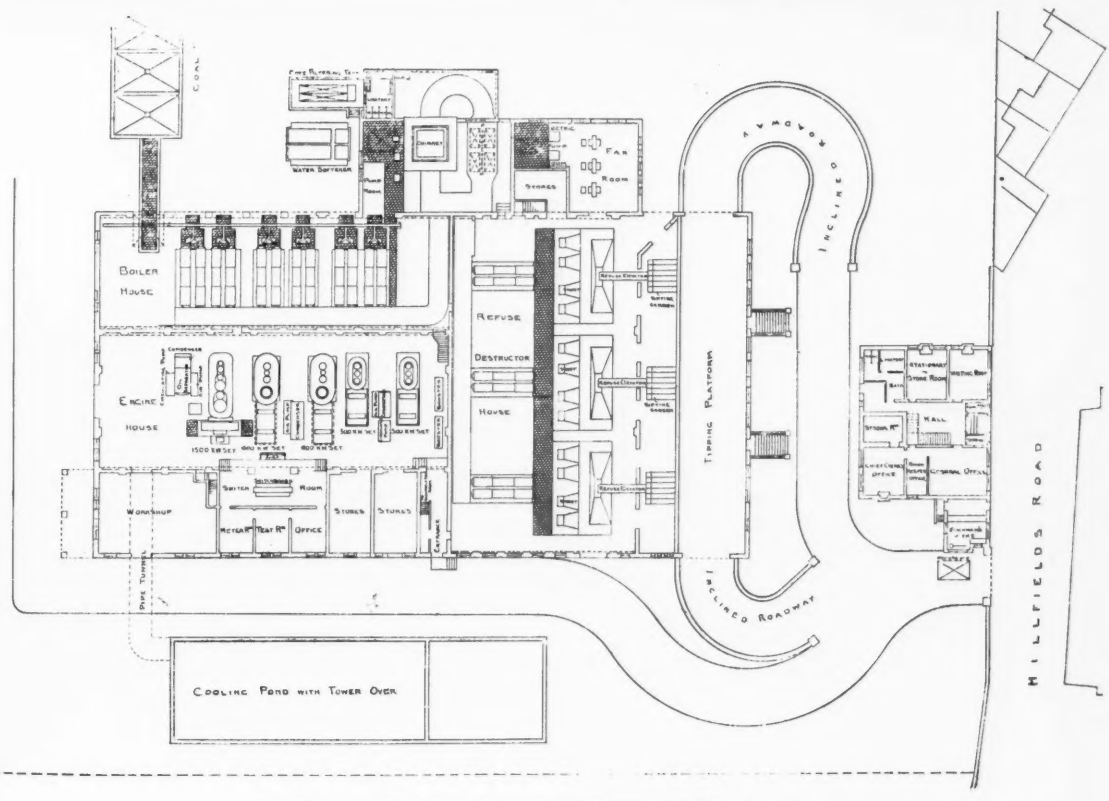
There are also two similar boilers of larger size, having each a heating surface of 4,020 sq. ft., and evaporating 14,000 lbs. per hour; these have superheaters of 452 sq. ft. each. The working pressure of all the boilers is 210 lbs. per sq. in. The boiler mountings are of Hopkinson's make, and the steam pipes, which were supplied by Messrs. Aiton and Co., of Willesden, are of steel, lagged with Haacke's composition. Each of these boilers is also provided with a Babcock water purifier. Illustrations are given herewith showing views from the front and over the top of the boilers.

Feed-water for the boilers is derived from the East London Water Co.'s mains, amounting to 2 or 2½ million gallons per annum, at 7½d per 1,000. The water is first passed through a purifier made by Messrs. Babcock & Wilcox, and situated near the stack; thence it is fed to the boilers by steam feed pumps, two made by Worthington, and one by Weir, and together capable of delivering 9,500 gallons per hour against the boiler pressure. Two Worthington electric feed pumps are also provided, each with a capacity of 1,000 gallons per hour.

Coal is brought to the works in barges, *viâ* the River Lea navigation, a special lay-bye having been constructed capable of accommodating three barges at once.

The coal conveying plant, which was supplied by the Mirrlees Watson Co., Ltd., of Glasgow, has a capacity of 20 tons of coal per hour. The coal is lifted from the barges by a 3-ton electrically-driven crane, which is provided with lifting, travelling and swinging gear, and is arranged to run on rails on the quay. The coal is delivered by the crane into the hopper of an Avery automatic weighing machine capable of weighing 5 cwts. at one operation; after which, the coal is discharged into another hopper below the weighing machine which feeds the automatic filler, which in turn supplies the conveyor buckets.

The conveyor is of the gravity bucket type, and is arranged for the double duty of lifting the coal and delivering it to any of the coal storage bunkers, or taking it from any of the coal storage bunkers and delivering it into a hopper in the boiler house, from which another conveyor is fed.



Plan of Hackney Electricity Works and Destructor

The automatic filler is mounted on rails to enable it to be run below any of the four delivery shoots from the coal bunkers, while automatic tippers are also provided, one over each of the coal storage bunkers and one over the boiler house bunker, which can be used for tipping the buckets at any required point.

The buckets are carried by an endless chain fitted with live rollers which run on rails. Ample provision is made for complete lubrication, for tightening the chain, and for other adjustments.

The bunker, which is shown in one of our views, is built of steel and concrete, and has a capacity of 500 tons. From the hopper in the boiler house the coal falls on a push-plate conveyor supplied by Messrs. Hughes & Stirling, and is carried along the front of the boilers to feed the mechanical stokers. Two kinds of coal are used, Broomhill nuts, at 12s. 6d., and Aitken Navigation rough small, at 13s. 8d.

The mechanical stokers are of the Babcock & Wilcox chain-grate type, the shafting being driven by a Crompton motor, of 10 H.P. We may remark in passing that various types of gearing are used for the different motor drives about the works, the object being to utilise them for exhibition purposes, for the enlightenment of prospective powers users; this is a practical notion which is worthy of imitation.

Ashes from the boilers are wheeled away to the tipping ground, where the destructor slag is also dumped.

The steam piping, as already mentioned, consists simply of a single main, with branches to the boilers and engines, and is entirely in the boiler house. At the point of junction between the small and large boilers an expansion loop is inserted in the course of the main pipe. Steam traps are freely used in the boiler house and engine room.

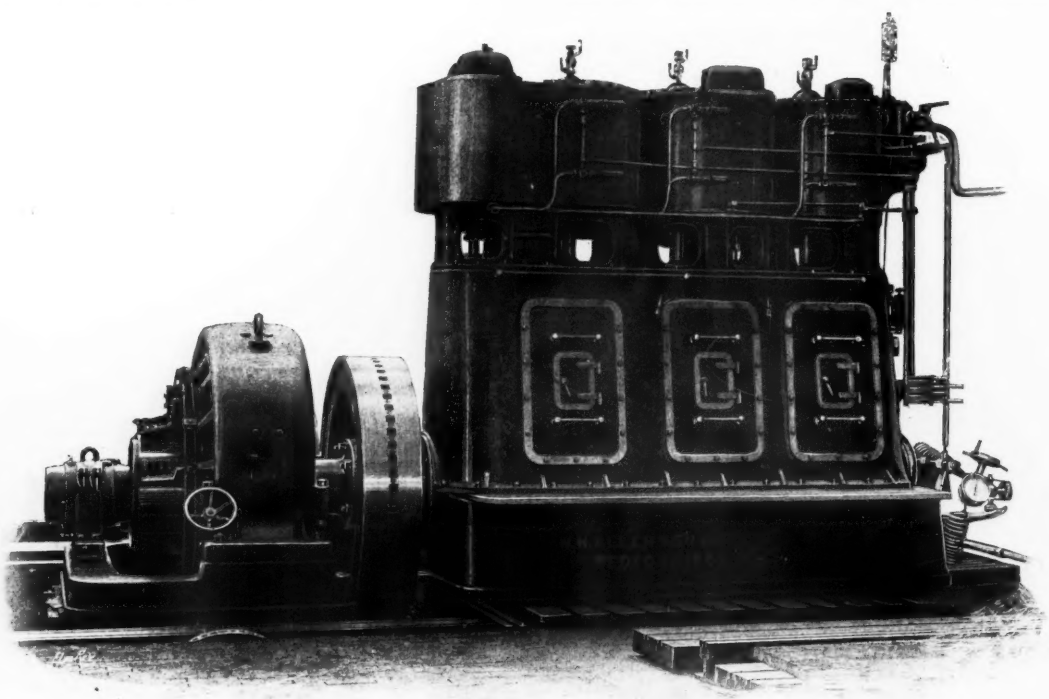
The engine room lies parallel to the boiler house, and is a lofty room 130 ft. long × 50 ft. wide, lined entirely with Kent's Crystopal tiling, and well lighted from the roof; the appearance of the interior, of which we give a general view, is therefore exceedingly bright and clean. The switchboard is situated in a recess near the middle of one side of the room, on a level several feet above the engine room floor, and commands a view of all the generating plant. The room is traversed by a 10-ton crane built by Messrs. Higginbottom & Mannock, of Manchester.

The generating plant at present installed consists of two Willans engines each coupled to two Johnson-Lundell generators of 150 KW. each (one of the Willans engines also drives a 72-KW. Westinghouse boosting dynamo); two Belliss engines each coupled to two Johnson-Lundell generators of 300 KW. each; and one Belliss engine, coupled to a British Westinghouse generator of 1,500 KW., making a total capacity of 3,372 KW. All the engines are of the vertical triple-expansion enclosed high-speed type, and are provided with condensing plant. In addition there is a booster of 50 KW. driven by a motor.

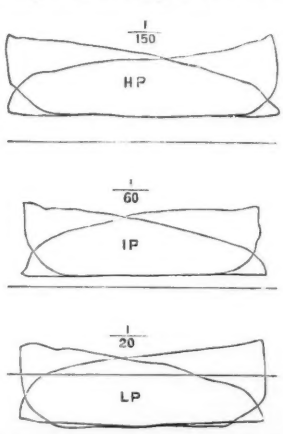
(To be concluded.)

A NEW HIGH-SPEED TRIPLE-EXPANSION ENGINE.

A GOOD example of recent progress in this country in the construction of high-speed electrical generating plant for power purposes is shown in the illustration below, which is taken from a photograph of a 580-I.H.P. triple-expansion engine by Messrs. W. H. Allen, Son & Co., Ltd., coupled direct to a 375-KW. continuous-current dynamo by the British Westinghouse Co., of Manchester, running at 325 revolutions per minute, and capable of developing 25 per cent. overload for two hours. The engine, which has been built to the order of the Fairfield Shipbuilding and Engineering Co., Ltd., of Govan, Glasgow, is of Messrs. Allen's standard three-cylinder, double-acting, triple-expansion, vertical enclosed type, the cylinders driving three cranks set at angles of 120°, and has been designed throughout with a view to obtaining economical results over widely varying conditions of load.



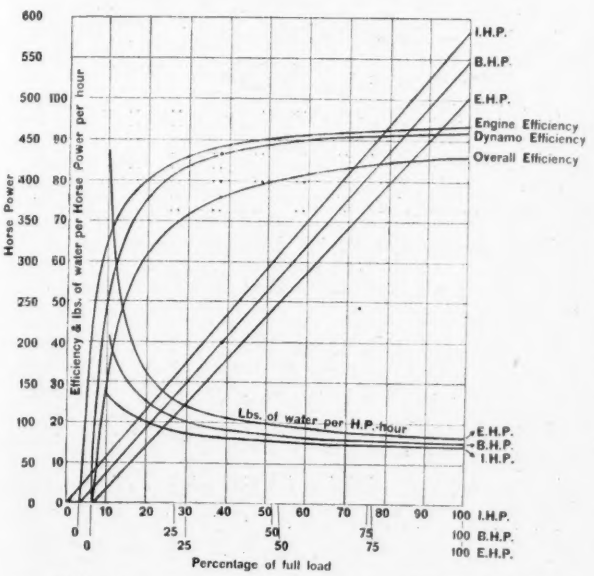
W. H. ALLEN, SON & CO.'S TRIPLE-EXPANSION ENGINE, COUPLED TO WESTINGHOUSE 375-KW. DYNAMO.



INDICATOR CARDS FROM ALLEN ENGINE.

The dimensions of the cylinders and the successive points of cut-off are so arranged as to produce an equal distribution of power between the three cylinders, thereby ensuring an exceedingly even turning moment throughout the revolution of the engine. The weights of the reciprocating parts on each crank are also equalised, in order to eliminate the resultant vertical and horizontal forces due to the inertia of the moving parts; there remain consequently only two couples to be balanced respectively in vertical and horizontal planes. As is well known, the complete elimination of these latter couples by any arrangement of revolving weights is a practical impossibility, but in the case under notice they have been reduced to a minimum by balance weights, so arranged that the radii of their respective centres of mass are set at a small angle to the crank radius, in order to reduce the unbalanced couples due to the inertia of the valve gear, as well as those of the main reciprocating parts. The success of this system of balancing was a noticeable fact during the trials, and was amply demonstrated by the steadiness of the engine when running without holding-down bolts, and standing on a smooth surface plate. The three cylinders are respectively 13 in., 20 in. and 30 in. in diameter, with a stroke of 13 in., and are made of a special mixture of hard and tough close-grained cast-iron.

The intermediate and low-pressure pistons are of cast-steel, and are fitted with "Rowan's" packing rings; the high-pressure piston is of cast-iron, of solid block type, and is fitted with a solid packing ring of rectangular section. The valves are all of the solid piston type, and take steam on the inside edges, thereby diminishing the pressure on the glands, as compared with valves taking steam on



Efficiency and Steam Consumption of Allen-Westinghouse Steam-Dynamo.

the outer edges. The whole of the working parts of the engine are enclosed in a neatly designed and substantial cast-iron trunk, the walls of which carry the slides for the main crossheads. Easy access to the interior of the trunk is provided by three large doors.

Each cylinder with its distance piece is completely isolated from each of the other cylinders, this design having been adopted by the makers for all their standard types of engines, excepting the smaller two-cylinder types, as it ensures that there shall be no distortion of the frame of the engine under any conditions of varying temperature. The massive cast-iron bedplate forms a reservoir from which oil is supplied at a pressure of about 15 lbs. per sq. in. to all the working parts by means of a small valveless force pump driven from one of the eccentrics.

The crankshaft, piston rods, &c., are all of Siemens-Martin steel; the high-pressure valve eccentric is keyed on the shaft, and the remaining two eccentrics are forged in one piece with the shaft.

The whole of the bearings except the crosshead bearings, which are of gun-metal, are lined with white metal.

The governor is of the company's standard crankshaft type, and can be regulated by hand whilst the engine is running; it operates a compound double-beat valve of special design, placed between the stop-valve and the engine, and so arranged that at overload steam is by-passed direct to the low-pressure cylinder. On the official trial the tests of the governor showed a steady speed variation from no-load to full-load of 1·9 per cent. and a momentary variation when the whole load was thrown off or on of 5 per cent.; values well within the specified limits.

The fly-wheel is of the solid disc pattern, forced on to the end of the crankshaft and securely keyed.

The cylinders, &c., are all lagged with asbestos non-conducting composition, and are neatly covered with blue planished sheet steel, the whole presenting a very neat appearance.

Appended are a few diagrams and test figures taken from the official trials recently carried out at the Queen's Engineering Works, Bedford.

Trial Results (Official) 13 in., 20 in., and 30 in. × 13 in. Triple-Expansion Engine.

Main steam pressure	150 lbs. per sq. in.
Throttled steam pressure	143 lbs. " "
Mean I.H.P.	578
Mean B.H.P.	540
Mean R.P.M.	327
Mean vacuum at engine exhaust ...	25·35 in. mercury
Total lbs. of water per hour ...	... 8,190 lbs.
Water per I.H.P. per hour ...	... 14·2 lbs.
Water per B.H.P. per hour ...	... 15·2 lbs.
Mechanical efficiency	... 93·5 per cent.

The indicator cards shown on p. 426 are samples of those taken during the official trial, and the order in which the cranks lead and follow is that given.

None of the cylinders have steam jackets, as experience shows that their effect at such high speeds is so slight as to make it not worth the increased first cost in fitting them.

We give a number of curves deduced from readings taken during the official trials, which show the efficiencies and steam consumptions throughout.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 422.)

Revolution in Cable Codes.—Simultaneously with the publication of the notice in the daily Press that the Postmaster-General had forwarded to the London Chamber of Commerce a copy of the revised rules respecting code and cypher in international telegraphy, which will come into force on July 1st next, the last development of Pantelegraphy and an explanation of the general system reached our hands from the Pantelegraphy Publishing Co., of 36, Lime Street, London, E.C. It appears, also, that the Postmaster-General has addressed a letter to compilers of codes, stating that the admission of artificial combinations in telegrams as code language rests on the assumption that they will be easy to pronounce and to transmit, and, if not, they will be considered contrary to the spirit of the decision of the last Telegraph Conference, thus, in our mind, raising the opportunity for a very pretty quarrel, which it has been so long the desire to obviate. Having once departed from dictionary words, we could never see the object of stipulating for pronounceable "mongrels," and we do not think that the objections now raised by the Postmaster-General will result in the enforcing of regulations recently passed at the Conference any more than when proper words were required. It has always seemed best to us to recognise the position, and face it by accepting anything and placing charges on a letter basis, or take any combination of letters and make the word limit seven for every telegram, plain code, cypher or mixed. Mr. Baronio claims for his method that he takes advantage of the system as it exists, and he quotes examples as "abonamenma" and "isapatornu," which appear to us as difficult to manipulate as any succession of consonants. He should be very well satisfied, as he claims to be able to make no less than 11,000 million combinations, and to effect a saving of 75 per cent. and more over present figure codes. How far this claim is justified we cannot say, but the method proposed of avoiding errors would appear to be sound so far as errors may be avoided or easily detected in the rush and scurry of telegraph work. It is also stated that the opinion that dictionary words are the best for code purposes is a fallacy which has had its day, but we cannot quite follow this, and would rather advance the thought that the mixed words of the "mongrel" kind are the offenders in respect to inaccuracy, and also that if the code words in the Berne official vocabulary had been revised in a manner to eliminate all objections and adopted, there would have been a standard at every office for verification. Operators would in time have become accustomed to the words, and the percentage of errors probably reduced. We agree with the explanation given on the Pantelegraphy Translating Card, that "pardonable errors are fully covered by their detector, but no plan can possibly be devised to guard against negligence." In our issue of June 12th last we dealt with Mr. James Nicolson's code system, which also claimed all the advantages as to avoidance of errors, &c. No doubt Mr. Baronio's system is excellent and ingenious, and should find many adherents, especially if the saving of 75 per cent. and upwards is effected on the cost of telegrams.

Cable Cutting in Time of War.—With regard to the leader in our issue of 4th inst. entitled as above, we quote the following opportune extract from a Moscow telegram to the *Standard* from its own correspondent, as showing the importance attached to uninterrupted commercial relations by the American and Russian Governments:—"The Americans are even more violently abused than the English, the latest cause of offence being the proposal to lay another cable to connect Japan, the Philippines, and the Pacific Coast of the United States in view of the possibility of the Japan-Shanghai cable being cut by the Russians and so isolating American commercial relations with the Far East."

Lecture.—Before the Institute of Marine Engineers (Bristol Channel Centre) recently, a paper on "The Application of Electrical Power on Cargo Steamers," was read by Mr. D. K. Roberts, M.I.M.E.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—March 31st. Two water-tube boilers and accessories. See "Official Notices" to-day.

Aston Manor.—March 14th. Water-tube boilers, superheater, and stoker. See "Official Notices" February 26th.

Austria.—March 20th. The Municipal Authorities of Retz are inviting tenders until March 20th for the establishment of a central electric lighting station in the town.

Birmingham.—March 30th. The Handsworth U.D.C. invites tenders for contract No. 1 (Holyhead Road)—permanent way, paving and road work and overhead equipment. See "Official Notices" to-day.

Canary Islands.—March 23rd. Electric tramway between San Cristobal de la Laguna and Tacoronte (Canaries). See this column for February 19th.

Chili.—June 28th. Electric lighting of the city of Punta Arenas (Straits of Magellan). See this column for February 19th.

Edinburgh.—March 14th. Arc lamp carbons, box frames and covers, for one year. See "Official Notices" February 26th.

Finchley.—March 12th. Free wiring proposals. See "Official Notices" February 26th.

Gainsborough.—March 16th. Telephones and fire alarms for the U.D.C. See "Official Notices" February 19th.

Gravesend.—March 12th. Stores, &c., for the Electricity Department. See "Official Notices" February 26th.

Ilford.—March 22nd. One 1,000-KW. steam dynamo, switchboard work, condensing plant, water purifying plant, pipework, cables, &c. See "Official Notices" February 26th.

Keighley.—March 25th. Rails, overhead equipment, cars, cables, switchboard, car-sheds, &c., for the tramway scheme. See "Official Notices" to-day.

Lincoln.—March 21st. Water-tube boiler, engine and C.C. dynamo. See "Official Notices" March 4th.

Loughborough.—March 12th. Dryback boilers, condenser, and battery for the electricity works. See "Official Notices" February 26th.

May-Oatway Fire Installations.—March 16th. The company invites tenders for installations connecting certain premises with the Glasgow Fire Brigade. See "Official Notices" to-day.

Metropolitan Asylums Board.—March 22nd. Fire alarms and telephones, at Leavesden Asylum. See "Official Notices" March 4th.

Newport (Mon.).—March 21st. Boosters, balancers, switchboards, tramway poles, overhead work, section pillars, cables, and trolley wire for the Corporation. See "Official Notices" March 4th.

Norwich.—March 14th. Cables, wires, lamps, meters and crane for the Electricity Department. See "Official Notices" March 4th.

Poplar.—March 12th. Two 1,000-KW. turbo-alternators (three-phase), and condensing plant. See "Official Notices" March 4th.

St. Anne's.—March 26th. Condensing plant and cooling tower. See "Official Notices" to-day.

Salford.—March 19th. Electric fittings, lamps (arc and incandescent), cables, pipes, &c. See "Official Notices" March 4th.

South Shields.—March 12th. The Corporation invites offers for the lease of certain tramways. See "Official Notices" January 15th.

Spain.—March 20th. The establishment and working during a period of 20 years, of a telephone exchange in the town of Figueras. See this column for February 26th.

Spain.—March 21st. Electric tramways in the town of Seville. See this column for February 19th.

Spain.—March 28th. Tenders for the lighting of the town of Plasencia.

Spain.—March 28th. The Spanish Post and Telegraph Authorities are inviting tenders for the establishment of a telephone line between Gijon and Pola de Siero, *viâ* Granda and La Collada. Particulars may be obtained from, and tenders are to be sent to, La Direccion General de Correo y Telegrafos, Carretas, 10, Madrid.

Stepney.—March 14th. 1,000-KW. steam turbine-driven double current generator, Babcock boilers, economisers, induced draught, piping, &c. See "Official Notices" February 26th.

Stockport.—March 30th. One 500-KW. steam generator. See "Official Notices" to-day.

Sunderland.—March 31st. India-rubber cables for a year. See "Official Notices" March 4th.

Swindon.—March 25th. Tramcar depôt lighting. See "Official Notices" to-day.

Swindon.—March 31st. Water softener, 60-KW. motor-generator, switchgear, lamps, cables, oils and meters. See "Official Notices" to-day.

Wallasey.—March 16th. A.C. transformers for two years. See "Official Notices" February 26th.

Warrington.—March 14th. Paper cables and electric motors for 12 months. See "Official Notices" March 4th.

Wimbledon.—March 18th. Stores for the Electricity Department. See "Official Notices" February 19th.

Wrexham.—March 12th. Stores for the Electricity Department. See "Official Notices" February 19th.

CLOSED.

Brighton.—The Corporation received the following tenders for a 20-ton four-motor overhead travelling crane for the Southwick power station:—

C. A. Musker & Co.	£990
Krane Ludwig Stuckenholz Co., Westphalia	1,054
Glasgow Electric Crane Co. (accepted)	1,100
Sunderland Forge Co.	1,170
Carrick & Ritchie	1,175
Jessop & Appleby	1,177
T. Larmuth & Co.	1,250
British Westinghouse Co.	1,254

Ealing.—The Corporation has accepted the tender of Messrs. Siemens Bros & Co., Ltd., for a 750-KW. Siemens-Paxman steam alternator at £5,811, and that of Messrs. Bertrams, Ltd., of Edinburgh, for the central surface condensing plant at £2,360.

Erith.—The British Westinghouse Co. has just received an order from the U.D.C. for a 500-KW. three-phase engine-type alternator to operate at 3,000 volts 50 cycles.

Hammersmith.—The B.C. has accepted the following tenders for annual supplies:—

The General Electric Co., Ltd., incandescent electric lamps, electrical goods (accessories and insulating).
Messrs. Johnson & Phillips, arc lamp accessories, arc lamp globes and shades.
Mr. A. A. James, commutator brushes.

The tenders for insulated wires were:—

Anchor Cable Co. (accepted)	£269
Johnson & Phillips	280
Liverpool Electric Cable Co.	284
W. T. Glover & Co.	288
British Insulated & Helsby Cable Co.	298
Siemens Bros. & Co.	323
General Electric Co.	324
Western Electric Co.	325
Connolly, Ltd.	325

Kingston.—The Guardians have accepted the tender (£2,074) of Messrs. C. Oldridge & Sons, Kingston, for the electric lighting of the Infirmary premises.

Leeds.—Messrs. S. Dixon & Son, Ltd., have received an order for six of their patent point shifters from the Leeds City Tramways Department, to be fixed within the next month.

Newport (Mon.).—The Electricity and Tramways Committee has accepted the tender of Messrs. Dick, Kerr & Co., Ltd., for 10 tramcars at £5,046 10s.

Salford.—The T.C. has accepted the following tenders:—

Pendleton Ironworks Co., Ltd., steel rails and turn-outs.
Mather & Platt, Ltd., for motors.
Chamberlain & Hookham, Ltd., for continuous-current house meters.

West Ham.—The Corporation accepted on Tuesday the following tenders to supply the articles named, during the ensuing 12 months:—

British Insulated & Helsby Cables, Ltd., cables; General Electric Co., incandescent electric lamps, 100 volts; British Thomson-Houston Co., incandescent electric lamps, 200 volts; Imperial Lighting Co., house cut-out boxes; Ferranti, Ltd., meters; British Electric Transformer Co., transformers; Mosers, Ltd., ironmongery (Electricity Department); Middleton Bros., engine room stores.

Wigan.—The E.L. and Tramways Committee has accepted the tender of Messrs. J. G. White & Co., Ltd., for the construction of the electric tramways and for the overhead equipment.

FORTHCOMING EVENTS.

Friday, March 11th.—At 3 p.m. Junior Institution of Engineers. Visit to the E.P.S. Co.'s works at Millwall.

At 7.30 p.m. I.E.E. (Manchester Students). Mr. J. W. Bell on "Switchgear for Traction and Transmission."

At 8 p.m. Physical Society. "The Whirling and Transverse Vibrations of Shafts," by Dr. C. Chree.

At 8 p.m. Institution of Civil Engineers (Students). "The Premium System of Payment for Labour," by Mr. W. G. Banister.

Saturday, March 12th.—At 3 p.m. Royal Institution. Lord Rayleigh on "The Life and Work of Stokes." (Lecture IV.)

At 7.30 p.m. West Hartlepool College Scientific Society. Paper on the "Three-Wire System."

Monday, March 14th.—At 8 p.m. Society of Arts. Mr. B. Blount on "Recent Advances in Electro-Chemistry." (Lecture II.)

Wednesday, March 16th.—Institution of Electrical Engineers (Birmingham). Visit to the B. T.-H. Co.'s works, Rugby. Train, New Street at 2.10 p.m. At 7.30 p.m.—Mr. W. E. Groves on "Localisation of Faults on Low-Tension Networks."

At 7.30 p.m. Institution of Electrical Engineers (Students). Mr. L. A. Lewis on "Notes on Commercial and Experimental Testing of Continuous Current Machinery."

Saturday, March 19th.—Institution of Electrical Engineers (Glasgow). Smoking Concert at the Grand Hotel.

Association of Engineers-in-Charge. Annual dinner.

At 7 p.m. Junior Institution of Engineers. Conversazione.

NOTES.

The Johannesburg Municipal Contract.—We understand that the Johannesburg Council has adopted the recommendations of Messrs. Mordey & Dawbarn, consulting engineers, for the employment of gas plant for the whole of its large lighting, power, and tramway undertaking. Our readers will remember that when the matter was opened to public tender, estimates were invited for both gas and steam plant, but the Council has now finally adopted the gas principle, and it is practically certain that within the next few days contracts will be duly entered into. The units will be of 1,000-H.P. and 2,000-H.P. size, the gas engines being of the Oechelhäuser type. Both the engines and the producers are to be of British manufacture. Report has it that the entire contract for the gas producers, engines, generators, &c., has been given to Messrs. Siemens Bros. & Co., Ltd., of London.

I.E.E. (Manchester Students' Section).—The newly-formed students' section has now got to work, and arrangements have been made to hold the meetings in the Municipal School of Technology. The following papers have been promised, viz.:—

Friday, March 11th, 1904.—"Switchgear for Traction and Transmission," by Mr. John W. Bell (vice-chairman).

Friday, March 25th, 1904.—"Photometric Testing," by Mr. D. Livingston Sands.

Friday, April 8th, 1904.—"Direct-Current Controllers," by Mr. H. W. Dutton.

Through the courtesy of the officials of the Manchester Corporation electricity department, about 150 students visited the generating stations on Saturday afternoon last. It is intended to visit Messrs. W. T. Glover's cable works, Trafford Park, on Saturday, April 9th.

Electric Belts in Melbourne.—The *Melbourne Age* for January 27th contains a report of a case against the Dr. M'Laughlin Electric Belt Co. there, in which plaintiff, John Young, a miner, claimed to recover £3, which he had paid for a belt. Young, who resided many miles away, saw a reference to the belts in the newspapers, and wrote for a No. 3 belt, sending £3. He subsequently filled in answers to a list of questions, and was told that what he really required was a No. 7 belt costing £7. He had voluminous correspondence with the company ("enough to paper a room with"). He did not take the No. 7 belt, but demanded the return of his £3. The pains in his back left him, but he never received the belt; the correspondence cured him. An order was made against the company for £3 16s. 5d.

Royal Society.—The following papers were down for reading yesterday afternoon:—

Prof. J. Dewar, F.R.S., "On Electric Resistance Thermometry at the Temperature of Boiling Hydrogen."

Hon. R. J. Strutt, on "A Study of the Radio-Activity of Certain Minerals and Mineral Waters," communicated by Lord Rayleigh, O.M., F.R.S.

I.E.E. (Leeds Section).—The first annual dinner was held at the Hotel Metropole, Leeds, on 4th inst., Mr. H. Dickinson presiding. The toast of "The Section" was proposed by Mr. R. K. Gray, the president of the Institution. The toast of "The Corporation and City of Leeds," was proposed by Mr. Robt. Hammond.

Appointments Vacant.—The Public Works Department of the Federated Malay States wants an executive engineer for the construction of hydraulic works in connection with the electric lighting of Kuala Lumpor (£420); junior assistants are wanted for the Newcastle-upon-Tyne Electric Supply Co. (N.E.Ry. scheme); electrical engineer for Radcliffe U.D.C. (£150).

South African Notes.—Our Durban correspondent says:—"The Natal Government's floating dock for the Harbour Department of Durban, which arrived on February 9th, shows that electricity is to play an important point in the future development of the port. The length of the dock is 475 ft., and its width is 96 ft. 2 in., and has a lifting capacity of 8,500 tons. Its electrical equipment is very complete, and consists of a marine type boiler by Clark, Chapman & Co., and two steam dynamos, duplicates of each other. The lighting of the dock is carried out by 200-C.P. lamps which are fixed along the top deck of the walls, and portable lamps are provided to carry to the various parts when a ship is in the dock for repairs, and the engine and boiler rooms are also suitably lighted. Messrs. Holmes & Co. were the electrical contractors. Direct current is to be used at 100 volts. The dock also brought out a floating workshop, which is lit throughout by electricity; it contains a very complete set of electrically-driven machines, each machine being direct coupled to a D.C. Holmes motor, deriving its current from a six-pole dynamo giving 300 amperes at a pressure of 100 volts, which is driven by a Robey compound engine at 320 revs. per minute.

Durban (Natal) Electricity Department.—The second annual gathering of the electricity department of the Durban Corporation took place at the Grosvenor Hotel on Feb. 9. Mr. J. Roberts, borough electrical engineer, occupied the chair, and was supported by the Mayor, Town Treasurer, Town Clerk, the chairman of the Electric Light Committee, and other guests, the company numbering in all 64. The Mayor submitted the toast, "The Department," and said that they might look forward to great developments in Durban as far as electricity was concerned, and he congratulated the department on its success. The electrical engineer, in replying, mentioned the fact that some five years ago his staff was only three, whereas now it was 96. He was pleased to see so many present that night, and, as he was about to visit England on a six months' holiday, he took this opportunity of saying *au revoir*. Mr. Taylor proposed the health of the chairman of the Electric Light Committee, which was suitably responded to. Mr. Poole gave "Our Guests," to which Mr. Dives replied. The arrangements for the dinner and the subsequent smoking concert were in the hands of the following committee, with Mr. Poole as hon. sec.:—Messrs. Taylor, White, Woods, Smith, Middleton and Brokensha.

British Central Africa.—The new electric power station at Zomba was, when the mail left, rapidly approaching completion. The building is in every way substantially constructed. The new dynamos were expected to arrive from Chinde shortly.

Johannesburg.—Some sensation was caused the other night in Commissioner Street through an escape of electric current. One horse, which was tied to a pole, was killed, and several civilians received severe shocks.

Heilbron (O.R. Colony).—The electric lighting concession for this town has been given to the Johannesburg house of Messrs. Harris, Lee & Co.

Central South African Railway.—We learn that Gilbert enclosed alternating arc lamps, which are largely used by this railway, are giving great satisfaction.

Junior Institution of Engineers.—At the meeting of this Institution held at the Westminster Palace Hotel, on March 4th, the chairman, Mr. Samuel Cutler, Junr. presiding, a paper was read by Mr. G. C. Allingham, entitled "Notes on Electric Accumulators." After a brief reference to the Edison and other types of cell, the author directed his remarks to the lead storage cell. Motor car and other portable cells were also considered. A discussion followed in which Messrs. F. S. Pilling, L. M. Ferreira, W. Alston, J. R. Bowden, W. Fennell, W. T. George, A. W. Marshall, E. S. New, and Ancher, took part. A vote of thanks was accorded the author, and the proceedings closed with the announcement of to-day's visit to the works of the Electrical Power Storage Co., at Millwall.

The McMillan Memorial Fund.—Our readers will be interested to learn what progress has so far been made with this fund. The number of subscribers in the different classes of membership is 661, and in addition 31 subscriptions (£57 10s.) have been received from outside sources, the total being well over £900. The averages are approximately as follows:—The donations received from 256 members have averaged £2 each; those from 184 Associate members averaged 15s.; those from 170 Associates averaged 13s. 6d.; and 88 students subscribed 5s. 9d. each (average). There are also three honorary members' subscriptions averaging £7 10s. 6d., and three foreign members have together subscribed £3 3s. It will be seen from the above that the average amounts subscribed have been in excess of the amount suggested by the President's circular. This is very satisfactory indeed, but is disappointing to find that only 661 out of the total membership of 4,800 odd have yet been able to send in their donations. Everyone in the electrical industry is by this time familiar with the splendid service which the late secretary rendered, and the claims of the fund should hardly need further urging. But we are constrained to give one more reminder to all who have not yet done their part for this very worthy object, and appeal to them to send their cheques forward to the president (Mr. R. K. Gray) without further delay. It is the hope of the Council that the fund may reach £2,000 so that there is some £1,100 still needed.

Personal.—At Hamilton House, on the 13th ult., a silver tea and coffee service, which had been subscribed for by the staff of Callender's Cable and Construction Co., Ltd., was presented to Mr. F. E. Wilkinson, who is leaving the service of the company to take up the position of secretary to the British and American

Mortgage Co. Mr. T. O. Callender made the presentation, and in a few chosen words, eulogised the services rendered by Mr. F. E. Wilkinson to the company.

St. Louis.—There are to be innumerable engineering congresses at St. Louis this year. The latest announcement to hand is respecting the International Engineering Congress, which is to be held from October 3rd to 8th under the auspices of the American Society of Civil Engineers. The preliminary list of subjects to be brought forward includes the following:—(7) Turbines and water wheels; (10) Underground railways; (11) Locomotives and other rolling stock; (13) The substitution of electricity for steam as a motive power; (15) Disposal of municipal refuse; (16) Ventilation of tunnels; (25) Steam turbines; (26) Electrical power: (*a*) generating stations, (*b*) transmission; (32) Mining engineering; (33) Engineering education.

Electric Traction on Ordinary Railways. — On February 13th, delegates of the Swiss Government Commission for Electric Plant, and of the Swiss State railways, inspected the electric traction test plant made by the Maschinenfabrik Oerlikon, near Zurich, with reference to the experiments which are to take place on the Seebach-Wettingen line of the Swiss State Railways, roughly 12 miles.

An electric locomotive of 400 H.P. normal, fed by single-phase current at a pressure of up to 15,000 volts, was run on the provisional track. This locomotive is a new improvement in the development of electric traction on railways, and the first test has shown the possibility of conveying current to railway trains on even very long tracks in an economic and essentially in a simple way. The economy is effected by the possibility of using very high pressure, and the simplicity is due to the use of single-phase current combined with a special device for collecting the current, designed by the Maschinenfabrik Oerlikon.

The experimental locomotive is able to pull on level track a 500-ton goods train (*i.e.*, about 30 average loaded trucks) for any length of time at a speed of 25 miles an hour. The necessary current is only 37 amperes, which corresponds approximately with that taken off a trolley line by a fully loaded ordinary tramcar at a pressure of 500 volts.

The new current collecting device patented by the Maschinenfabrik Oerlikon has been specially designed for high pressure and single contact lines, and differs essentially from what has been done up to the present in this direction, especially with regard to simplicity and durability. The contact line in the open country consists of a single strong wire, which is not fixed on brackets or suspended above the track, but is clamped on the heads of the insulators themselves on the top of the poles at the side of the track at a height of 16 to 17 ft. The space above the track is therefore completely free, and such contact lines can be run on both sides of the track, either connected or independently. Another notable feature is that repairs can be made on the contact lines without obstructing the track. It is only at junctions where several tracks run parallel or cross each other, or in tunnels, stations, or under bridges, that the contact lines are run over the middle of the track, as in electric tramways. The current collector follows the contact line automatically without shock or sparking, whatever its position relative to the track. This method of collecting the current permits of its adaptation to existing railways whatever their clear profile.

In contrast to the contact arrangements as used up to the present, the contact piece of the Oerlikon device, the only part subject to wear and tear is of extremely small mass (about 3 lbs. of metal tubing), is cheap and easily renewed. The device collects the current at any speed, in any direction without adjustment, and with the contact wire in any position relative to the track. We are informed that the collector cannot possibly foul or tear down the contact line; and should the contact piece break or derail, which is a very remote possibility, it would fall back into such a low position that no part of it could touch the contact line.

Osmium Lamps.—L. Lombardi, in a recent issue of the *E.T.Z.*, describes his endeavours to determine as accurately as possible the temperature of osmium lamp filaments (using a process designed by Prof. H. F. Weber at the 1891 Frankfurt Congress) from the relation given between the absorbed energy and temperature; the author derives as an average value of the radiation constant, the figure $c = 0.0000164$. As an average of all the measurements made on osmium lamps, 1,435° is found to represent the temperature of normal luminous intensity, being 135° below the corresponding temperature for ordinary glow lamp carbon filaments. This striking result, that the normal temperature of the incandescent filament is so materially below that of carbon filaments, though the economy of osmium lamps is much better than that of ordinary carbon filament lamps, is illustrative of the high luminous power of the osmium filament. In virtue of this behaviour, the life of osmium lamps may evidently be much higher than the life of ordinary carbon lamps.

Preparation of Alkali and Alkaline Earth Hydroxides.—Mr. F. Jahn, of Philadelphia, has taken out an American patent for an electrolytic process for the preparation of alkali hydroxides (caustic alkalis), according to which an aqueous solution of the corresponding sulphide is treated in a bath using as anode some material in an extended and porous form, the sulphide of which is not chemically or physically acted upon by the electrolyte. For instance, in the manufacture of barium hydroxide (caustic baryta) an aqueous solution of barium sulphide is electrolysed with an anode of finely divided iron.

THE CENTRAL STATION ENGINEER.

Mr. G. E. Clarke has been appointed borough surveyor and electrical engineer at Boston (Lincolnshire).

Worthing T.C. has increased the salary of the assistant electrical engineer from £100 to £120 a year.

Wallasey has increased the salary of Mr. J. A. Crowther by £25 a year, and that of Major Greene, tramways manager, by £50 per annum.

The first exhibition of the Glasgow Corporation Electricity Department Photographic Society was opened on Friday, the 4th inst., by Mr. Chamen, the chief engineer. The society was formed in the spring of last year and there are now 27 members on the roll, all connected with the Electricity Department. The exhibits, which numbered 116, were divided into four classes.

On Saturday last, Mr. A. B. Hawes, late station superintendent at the Chester Electricity Works, was presented with an eight-day striking carriage clock, as a memento of the time he has spent at Chester. Mr. Hawes has obtained an appointment under the Midland Electric Power Co. The presentation took place in the engine room, and Mr. Dimmach, the chief assistant, officiated on behalf of the staff and workmen.

Crewe T.C. has increased the salary of Mr. W. T. Kerr, assistant electrical engineer from £150 to £175 per annum.

NEW COMPANIES REGISTERED.

Hove and Worthing Electric Tramways, Ltd. (80,239).—This company was registered on March 4th, with a capital of £100,000 in £5 shares, to carry on in the United Kingdom and elsewhere the business of carriers of passengers and goods, electrical engineers, electricians, general engineers, contractors, wharfingers, agents, manufacturers of and dealers in railway, tramway, electric, magnetic, galvanic and other apparatus, mechanical and chemical engineers, generators, accumulators, transmitters, users and suppliers of power, light, heat and sound by electricity, galvanism, magnetism, compressed air, gas, steam, oil, or other means, constructors and owners of tramways, railways, and other means of communication, manufacturers of cars and rolling stock, &c. The first subscribers (each with one share) are:—A. C. Miles, Merdiston, Bedford, director; W. G. Bond, 47, Devonshire Street, W., director; P. U. Gray, 475, Grove Green Road, Leytonstone, secretary; G. H. Godward, Mark Beech, Sutton Road, Muswell Hill, secretary; F. C. Cocking, 196, Friern Road, Dulwich, registrar; G. J. Somerville, 68, Kilmorie Road, Forest Hill, S.E., electrical engineer; R. P. Simpson, 4, The Grove, Boltons, S.W., director; and A. B. Gridley, 15, Worsley Road, Hampstead, N.W., secretary. No initial public issue. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, 1 share; remuneration, £50 each per annum and 5 per cent. of the distributed profits, divisible. Registered office, Donington House, Norfolk Street, W.C.

Musselburgh Construction Syndicate, Ltd. (80,196).—This company was registered on February 29th, with a capital of £76,000 in £1 shares, to adopt an agreement with the National Electric Construction Co., Ltd., and to carry on the business of railway and tramway proprietors, suppliers of electric light and power, electrical engineers, metal workers, contractors for the supply of electrical plant, producers and distributors of electrical energy, makers of cables, wires, lines, accumulators, dynamos, batteries, engines, lamps and meters, builders of stations and works, contractors, constructors and owners of telephone and telegraph lines, docks, canals, roads, and means of communication, &c. The first subscribers (each with one share) are:—R. S. Bain, 25a, Cockspur Street, S.W., chartered accountant; L. B. Schlesinger, 21, Cornhill, E.C., banker; W. B. Cownie, 84, Victoria Street, S.W., chartered accountant; J. T. Jervis, 28, Victoria Street, S.W., M.I.C.E.; F. E. Stanley, 34, Victoria Street, S.W., electrical engineer; R. Watson, 34, Victoria Street, S.W., accountant; and E. A. Mitchell, Cassioburg, Alma Road, Carshalton. No initial public issue. The number of directors is not to be less than three nor more than seven; the first are R. S. Bain, L. B Schlesinger, W. B. Cownie and J. T. Jervis; remuneration, £100 each per annum, and £100 extra for the chairman. Registered office, 34, Victoria Street, S.W.

Herberlein Co., Ltd. (80,193).—This company was registered on February 29th, with a capital of £10,000 in £1 shares, to carry on the business of manufacturers of and dealers in engineering and industrial material, machinery, stores and appliances for the purposes of brakes for railway and other purposes, and for the heating or electric lighting of railway or other carriages, vehicles, ships and public or private places, electricians, mechanical and electrical engineers, &c. The first subscribers (each with one share) are:—Hon. W. F. B. Massey Mainwaring, M.P., 30, Grosvenor Place, S.W.; W. Binns, 22, Arthur Road, Wimbledon Park, S.W.; Miss A. C. Fairholme, 20, Witherby Mansions, S.W.; F. C. Fairholme, Bolton Hall, near Rotherham, civil engineer; F. B. Passmore, Suffolk House, Laurence Pountney Hill, E.C., civil engineer; A. Jaffa, 138, Sunderland Avenue, W., secretary; and A. R. Dowling, 33, Vestry Road, Camberwell, S.E., clerk. No initial public issue. The first directors are the Hon. W. F. B. Massey Mainwaring, M.P., W. Binns and F. C. Fairholme; qualification, £30; remuneration, £50 each per annum. Registered office, Suffolk House, Laurence Pountney Lane, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Cape Electric Tramways, Ltd.—Particulars of £315,000 6 per cent. and £115,000 5 per cent. debentures, created by resolution of November 17th, 1897, and covered by trust deed of March 9th, 1898, have been filed in accordance with Sec. 14 (4) of the Companies' Act, 1900. Property charged by 6 per cent. debentures: (1) £130,000 shares in the Metropolitan Tramways Co., Ltd., (2) £45,000 shares in the Southern Suburbs of Cape Town Tramways Co., Ltd., (3) £158,000 shares in the City Tramways Co., Ltd., and (4) £120,000 shares in the Port Elizabeth Tramway Co., Ltd., as a second charge. The 5 per cent. debentures constitute a first specific charge on property No. 4, a second specific charge on properties Nos. 1, 2 and 3, and a floating charge on the company's general assets. Trustees: C. Rube and L. Breitmeyer, 180, Bishopsgate Street Within, E.C.

Notting Hill Electric Lighting Co., Ltd. (25,921).—Particulars of a series of debentures created by resolutions of May 25th, 1897, February 17th, 1903, and October 20th, 1903, to secure not more than half the amount of the subscribed and paid-up share capital for the time being, have been filed in accordance with Sec. 14 (4) of the Companies' Act, 1900. The debentures are secured by a trust deed of June 17th, 1897, and supplemental deed of June 30th, 1902. Property charged: The company's undertaking and property, present and future, except uncalled and unpaid capital. Trustees: Sir W. Crookes, 7, Kensington Park Gardens, London, and R. B. Martin, M.P., 10, Hill Street, Mayfair. (At the date of the last return, the paid-up capital amounted to £144,000.)

Vazson, Easterbrook & Co., Ltd., electrical and general engineers, Sheffield.—A debenture, dated February 17th, 1904, to secure £250, charged on the company's undertaking and property, present and future, including uncalled capital, has been registered. Holder: J. Baker, Glenbourne, Dore, near Sheffield.

Derbyshire and Nottinghamshire Electric Power Syndicate, Ltd. (69,618).—A memorandum of satisfaction in full of a charge dated March 19th, 1902, securing £9,000, has been filed.

Eversheds & Vignoles, Ltd., electrical engineers, London (43,206).—Issue, on February 15th, of £1,600 debentures, part of series created February 11th, 1902, to secure £15,000, charged on the company's undertaking and property, present and future, including uncalled capital and a specific charge to the extent of £2,500 in respect of shares issued since date of trust deed (February 11th, 1902). Trustees: Law Guarantee and Trust Society, Ltd., 49, Chancery Lane, W.C. Previously issued of same series: £12,000.

ELECTRICITY SUPPLY ACCOUNTS.

Barking Municipal Electrical Supply.

The yearly return of the Barking electrical department shows that this small undertaking is progressing in the right direction, despite the adverse conditions associated with the area of supply. The works costs have fallen to 2·41d. from 3d. per unit, and a small adverse balance remains on the year's working after meeting financial charges.

The prices charged are:—Private lighting, 4½d. per B.T.U.; power and heat, 3½d. to 1½d. per B.T.U.; public arc, £20, incandescent lighting, £4 per annum. Mr. A. H. Seabrook is the electrical engineer and manager.

General Statement.

For year ending March 31st—	1903.	1902.
Total capital expended	£40,448	£28,942
Number of units sold—		
Private supply	167,146	128,795
Public lighting	182,478	157,121
Total number of units sold	349,624	285,916
Equivalent No. of 8-c.p. lamps connected	16,658	14,000
Number of public lamps	18 A, 40 N, 450 inc.	15 arc.
Maximum load in kw.	250	230
Revenue account—		
Gross revenue	£5,648	£4,892
„ expenditure	£3,508	£3,572
„ profit	£2,140	£1,320
Average price obtained per unit—		
Private lighting	4·26d.	4·36d.
Public lighting	2·98d.	3·05d.

Revenue Account for Year ending March 31st, 1903.

Gross revenue	£5,648 = 3·87d.	per unit.
Works and distribution costs (inc. pub. ltg.)	£2,817 = 1·93d.	„
Total works costs	£3,508 = 2.41d.	„

Profit Statement.

Interest and sinking fund	£2,171
Balance on year's working	—31
Gross profit	£2,140

Wolverhampton Municipal Electrical Supply.

The result of the last year's working of Wolverhampton's electrical undertaking, is a considerable advance on its predecessors. Aided by a substantial traction load, at a good figure—both working expenses and revenue—show improvement; the former being reduced by about ·7d. per unit, despite abnormal distributing expenditure, and the latter having increased by about £8,000 over the previous year's figure.

The gross profit amounted to £11,060, and after meeting interest and sinking fund charges, a balance of £2,689 remained this, with £755 interest, &c., accumulated during the year, left a total sum in hand of £3,444, from which £965 was utilised for writing off the balance of the first cost of plant sold by the department—and £2,479 carried forward. In addition to the above, an amount of £50 provided in 1902 for bad debts was carried forward under that head.

The charges are:—For private lighting, 6d. and 3d. per unit; power, 2d. and 1d. per unit, maximum demand system; traction, 500,000 units at 2d., and 1½d. per unit after that amount. Mr. C. E. C. Shawfield is the borough electrical engineer.

General Statement.

For year ending March 31st—	1903.	1902.
Total capital expended	£156,999	£121,611
Number of units sold—		
Private supply	926,634	655,896
Public lighting	85,765	79,375
Traction	612,240	11,047
Total number of units sold	1,624,639	746,318
Equivalent No. of 8-c.p. lamps connected	54,578	40,953
Number of public lamps	53 arcs 22 inc.	51 arcs 3 inc.
Maximum load in kw.	1,190	772
Revenue account—		
Gross revenue	£21,147	£13,240
„ expenditure	£10,087	£6,746
„ profit	£11,060	£6,494
Average price obtained—		
Private lighting and traction	3·67d.	4·22d.
Public lighting	3·74d.	3·88d.
Traction	1·91d.	2·00d.

Revenue Account for Year Ending March 31st, 1903.

Gross revenue	£21,147 = 3·12d.	per unit.
Works and distribution costs (inc. pub. ltg.)	£8,091 = 1·19d.	„
Total works costs	£10,087 = 1·47d.	„

Profit Statement.

Interest on loans, &c.	£4,415
Sinking fund	3,956
Balance on year's working	2,689
Gross profit	£11,060

CITY NOTES.

The Johnson-Lundell Electric Traction Co.

An extraordinary general meeting of the above company was held on Friday last at the Holborn Restaurant to further consider the report of the directors' and shareholders' committee. This company, it will be remembered, was started some four years ago, the principal promoters being Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne. When a successful manufacturing concern turns its attention to company promoting, the results are not always satisfactory, and it is highly probable that their experience with the pioneering of the Johnson-Lundell Co., and previously with the Electric Vehicle Syndicate, will satisfy Messrs. J. H. Holmes & Co. that it is more profitable to stick to their legitimate work of manufacturing. The price of the patents acquired by the Johnson-Lundell Co. was some £200,000, payable half in cash and half in fully-paid shares. At the present moment these patents are apparently worthless; at any rate, they have been dropped for the time being, and the company now proposes to devote its energies to developing a regenerative system of motor control for which it holds the patents. The development of a satisfactory system of regenerative motor control has occupied the minds of a large number of electrical engineers, and a good system, in capable hands, ought to have a considerable commercial value. As a result of experiments made on tramcars in Newcastle-on-Tyne with the Johnson-Lundell apparatus, as much as 40 per cent. of the energy taken by the motors has been returned to the line. The system is such that it is impossible for the motormen to stop the car without returning some energy to the line. The amount, of course, depends on the number of times the car is started and stopped, and depends also on the nature of the ground traversed. Whether or not the directors will succeed in making money out of the system is, of course, problematical, although it was said on the highest expert authority that the original patents had a considerable commercial value. It is proposed to establish a workshop on a moderate scale in which the assembling and fitting of plant can be carried out, advantage being taken of the readiness of various firms to supply standard parts of which they make a speciality. As the company, therefore, would become a manufacturing concern competing with Messrs. J. H. Holmes & Co., Mr. L. W. Holmes, as a logical outcome of the situation, resigned his seat upon the board of which he was formerly chairman. It is now proposed to make a call upon the shareholders, the proposal being to call up 15s. a share, and the future of the company will be watched with considerable interest.

Metropolitan Electric Supply Co.

The directors' report for the year ending December 31st, 1903, shows that the capital expenditure, which at the end of 1902 amounted to £1,846,448, has now reached a total of £2,090,763, being an increase during the year of £244,315. Of this total the sum of £598,808 represents expenditure in Marylebone, which will be written off on completion of the purchase by the Borough Council. The gross revenue for the year amounted to £281,422, as compared with £261,073 in 1902, being an increase of £20,349. The cost of generation, which in 1902 was £113,747, amounted in 1903 to £98,593, or a decrease of £15,154. The report continues:—

"On August 7th the company obtained judgment in the High Court against the Marylebone Borough Council for payment of the sum of £1,212,000 due under the award, and for the repayment of capital expended in Marylebone since 1901. The date originally fixed by the Court for these payments was December 31st last, but an extension of time was subsequently granted until February 29th, 1904 (subject to payment on January 31st of £60,000 on account of the capital expenditure referred to), to enable the Council to promote a Bill in Parliament for the purpose of borrowing the money required. On 26th ult. a further extension of time was granted until April 30th next, subject to payment on the 31st inst. of an additional sum of £15,000 on account. Meanwhile it has been agreed that the company shall retain the profits in lieu of interest on the amount of the award, but interest is payable to the company in respect of capital expended since 1901. The arbitration held under the provisions of the London County Council (Improvements) Act, 1899, in connection with the compulsory acquisition by the Council of the generating works at Sardinia Street, has resulted in the company being awarded the sum of £183,150. It is expected that this money will shortly be received, and the new site to be provided by the Council vested in the company. During the past year the share capital of the company was increased from £1,000,000 to £1,500,000, by the creation of 100,000 4½ per cent. cumulative preference shares of £5 each. Of these, 65,104 shares were taken up at par by holders of ordinary shares under the terms of the circular, dated June 9th, 1904, and a further 7,919 shares were subsequently disposed of at a premium. The loans from bankers, which on December 31st, 1902, stood at £390,000, were reduced during the year to £290,000, and now stand at £210,000. The company have entered into an agreement with the Acton District Council for the supply of electricity in bulk, for the purpose of the Council's Provisional Order. The balance at the credit of the revenue account, before providing for depreciation, is £142,872. The directors have set aside £18,000 as an addition to the depreciation and reserve fund, which now amounts to £116,447, carrying to the credit of the net revenue account the sum of £124,872, which, with the balance brought forward from last account and other receipts, makes a total of £129,587. After deducting interest on debenture stocks and loans, dividend on preference shares and other charges, there remains a balance of £89,736. An interim dividend of 8s. per share (being at the rate of 8 per cent. per annum) on the ordinary share capital was paid on August 11th, 1903, amounting to £40,000, and the directors recommend that a further dividend of 9s. 6d. per share (being at the rate of 9½ per cent. per annum) on such shares be now paid, making a total distribution for the year of 17s. 6d. per share, or 8¾ per cent. This will absorb a further sum of £47,500, and leave a balance of £2,236 to be carried forward to the next account. The total number of 8-c.p. lamps connected at the end of 1903 was 823,000, being an increase of 100,000 during the year. The present number connected is 838,000."

London Electric Supply Corporation.

Mr. R. H. Benson presided at the meeting held last Friday at Winchester House. He explained that the Earl of Crawford, the chairman, was, by doctor's orders, compelled to winter abroad. The gross revenue for 1903 was £77,190, against £78,344 in 1902, a decrease of £1,154; the net revenue was £36,177, against £35,342, an increase of £835. The saving of expenses was entirely in the cost of generation, and practically all in coal. The year had been singularly free from fogs. The lamps increased by 17,877, from 201,487 to 219,364, and the units sold from 4,036,593 to 4,102,099. Notwithstanding these increases the gross revenue was reduced, the cause being competition, but the net result was better. There was a time when the company realised 6d. per unit, but now it was only 4¼d. on the average; so that they made more money by selling a larger quantity at a lower rate. Last year he led them to expect some improvement in revenue, partly from natural expansion, but chiefly from the tramways contract with the L.C.C. They had expected that the fruits of that contract would begin in October or November last, but as a matter of fact, they did not begin until January 17th, 1904, so that the benefit would come into this year. They were entirely satisfied with that contract, for experience to date had already shown that it was tending to reduce the average cost of generation. They expected that it would more than double their units sold, that the current year's sale would be 8 or 10 million units, compared with 4,100,000 last year. The contract was at a cheap rate, but the load came on mostly in the daytime, when the machinery would otherwise be working light. Their capital expenditure was £36,198, which was small for a company having such a large area and growing business. They could now foresee desirable capital expenditure aggregating £58,686, but the whole was not likely to be required this year. They had about £45,000 of borrowing powers unexercised, but it was not prudent to run that too fine. He was sanguine enough to think that the time would come when they would be able to provide for all capital expenditure by the sale of ordinary shares at par. Until that time came, the best course open was to increase, by a moderate amount, the authorised issue of the existing preference shares. After referring to the strengthening of the board by the election of Sir W. Pollett and Mr. R. D. Norton, the chairman intimated, in this connection, that following the course adopted by the late Lord Wantage and Earl Crawford, he had preferred to take no fees. The chairman moved the adoption of the report and payment of the preference dividend.

Mr. R. S. Bain, in seconding the motion, said that out of this year's capital expenditure they had extended the plant in readiness for the L.C.C. tramway supply. £7,000 was for five new boilers of 800 H.P. each, £6,000 was towards the cost of the new condensing plant, the new dynamo and feed pumps, and £10,600 for new mains. The gross receipts were less, but they had sold more units than in 1902. The cost per unit was reduced to 2·39d., as compared with 2·55d. in 1902. The coal consumption was only 14,964 tons, as compared with 16,241 in 1902, 18,900 in 1,901, and 26,710 in 1900. The new condensing plant was making good progress, and would be running in the autumn, and when it was completed there would be a further saving of 15 per cent. in the bill. There had been a great increase in the efficiency of the system; the percentage of units sold to units generated in 1894 was only 52½ per cent., but in 1903 it was 74 per cent., or an increase of 22 per cent., an efficiency which now compared with some continuous current companies, although this company's supply had to undergo two transformations.

The report was adopted, and the retiring directors and auditors were re-elected.

A resolution was subsequently passed increasing the capital by the creation of 20,000 £5 preference shares, which are to rank *pari passu* with the existing preference capital.

County of London and Brush Provincial Electric Lighting Co.

The directors' report for 1903 says that the capital expended during the year under review in respect of the London districts amounted to £133,772, making the total expenditure on account of those districts up to December 31st last £1,300,089.

The balance from last account was £4,956; and the balance from revenue, 1903, after deducting generation and distribution costs, rent, rates, taxes, wages, directors' fees, general establishment and other charges, and proportion of salaries, is £70,973; making a total available revenue for the year 1903 of £75,929.

(*a*) Interest on the first and second debenture stock and temporary loans, £27,875; (*b*) Interim dividend on 30,000 6 per cent. preference shares, £8,512; (*c*) Interim dividend on 40,000 ordinary shares (4 per cent. per annum), £7,566; (*d*) Amount carried to reserve for depreciation, repairs, renewals, &c., £10,000; (*e*) Carried to contingency account £500—£54,453; leaving for further distribution, £21,476.

The directors now recommend a further dividend at the rate of 6 per cent. on the preference shares for the half-year, and a further dividend on the ordinary shares for the half-year at the rate of 4 per cent. per annum. This will absorb £16,221, and leave a balance of £5,255 to be carried forward.

In order to provide the necessary funds for the development of the company's business, an issue of £250,000 4½ per cent. second debenture stock was made in April of last year at the price of 103 per cent. The London Electric Supply Corporation, Ltd., applied to Parliament last year for an extension order in competition with this company throughout the Borough of Camberwell. The Board of Trade, however, after holding a public inquiry and hearing evidence on both sides, refused to grant the order. The Borough Council of Bermondsey again applied for a competing Order for St. Olave, but the Board of Trade, without taking evidence, refused to grant the Order. The directors propose to change the name of the company to the "County of London Electric Supply Co., Ltd."

The profits derived from the company's London stations for 1903 amounted to £73,423 11s. 6d., against £61,698 16s. 6d. for 1902, being an increase of 19 per cent. for the year, while the generation and distribution costs and working expenses show an increase of 4·91 per cent. over the figures of 1902.

The total applications received at December 31st last amounted to the equivalent of 528,856 8-c.p. lamps, being an increase of 112,564 lamps for the year, as against 90,314 lamps for 1902. Included in these figures are 595 users of motors aggregating 5,837 H.P., showing an increase of 1,418 H.P. for 1903, of which 736 H.P. is in respect of the Wandsworth station. The total units sold were 5,754,633, as against 4,886,285 for the previous year. Additional generating plant for power purposes has been erected during the past year at the City Road station. With a view to providing for future extensions, the premises adjoining have been secured. At the company's Wandsworth station the building extensions commenced in 1902 have been completed during the past year, and additional generating plant to a capacity of 2,000 KW. to meet the rapidly-growing demand in the southern districts has been erected, and is now at work. The scheme of wiring premises on the rental and prepayment meter system introduced during last year is working satisfactorily. The scheme is particularly well suited to the smaller class of premises, which cover a considerable portion of the company's areas south of the Thames. During the year the company's charges for the supply of motive power have been revised and a sliding scale of discounts is now in operation, which has met with general approval.

The progress of the Bournemouth and Poole Electricity Supply Co. continues to be satisfactory. The directors have declared a dividend on the ordinary shares at the rate of 8 per cent. per annum for the year 1903.

The business of the Scottish House-to-House Electricity Co., Ltd., shows satisfactory progress. The Airdrie and Coatbridge Tramways commenced running on the 5th ult., the necessary power being supplied under contract by this company from its station at Coatbridge, thus providing a useful day load, and one which should, on the terms arranged, prove remunerative.

Statement of Electricity Generated, Sold, &c. (County of London E.S. Co.)

Units generated.	Quantity sold.				Quantity used on works.	Total quantity accounted for.	Quantity not accounted for.	Number of public lamps.	Total maximum supply demanded.
	Public lamps.	By contract.	Private consumers by meter.	Total sold.					
8,130,515	—	—	5,754,633	5,754,633	534,249	6,288,882	1,841,633	—	5,342 KW.

Ottawa Electric Street Railway Co.

At the tenth annual meeting, held recently, it was stated that 7,911,718 passengers had been carried during the last financial year, and that the gross receipts amounted to $348,889. The expenses, including interest on bonds, taxes, &c., amounted to $254.346, leaving a net profit of $94,542. Four quarterly dividends were declared, amounting to $69,284, leaving a balance of $25,258, of which amount $20,200 was placed to the contingencies account. The company's rolling stock at the present time consists of 23 open and 63 closed motor-cars, four trailers, three Postal cars, and a snow-clearing outfit.

W. T. Henley's Telegraph Works Co.

The directors' report for 1903 shows that during the year a net profit of £44,450 was made. After payment of directors' and auditors' fees, debenture interest and income-tax, and making the usual allowance for depreciation of buildings, plant, machinery, &c., there remains £36,743, making, with £25,967 brought forward from last year, a total of £62,710. The directors have transferred £1,000 to the debenture redemption sinking fund, and they recommend the payment of a dividend on the ordinary shares at the rate of 15 per cent. (less income-tax), including the interim dividend of 6 per cent. paid on September 1st last. These payments will, together with the preference dividend for the year, amount to £35,125, leaving a balance of £27,585 7s. 5d. to be carried forward.

The meeting is to be held at the offices of the company at 12.30 o'clock to-day.

Hart Accumulator Co.

The annual meeting was held at Stratford on March 2nd. Mr. G. Kidd, in moving the adoption of the report (see Electrical Review, February 26th), said that they were not paying so good a dividend as in the previous year, but the figures in the accounts would have allowed them to do so. They had opened a new branch at Birmingham, and were now doing a considerable business in battery plates for automobiles. A considerable portion of the company's business last year was composed of the replacing of batteries of other makers. The orders for the current year, January and February, were about up to the average, but the sales were in excess of the average of any preceding year.

The report was adopted, and a 12½ per cent. dividend approved.

Mr. E. J. Clark, the engineer and manager, in acknowledging a vote of thanks to the staff, said that, during the year, their duties had been more difficult than usual, owing to the keen competition.

An extraordinary general meeting followed, at which a resolution was approved, increasing the capital from £40,000 to £60,000 by the creation of 20,000 new preference shares at 6 per cent. The money was required for building a new factory, for which land had already been acquired. The estimated cost of the works was £13,000 or £14,000, but the money would not all be needed at once, as the work would be done section by section. The shares are to be offered to the existing shareholders according to their holdings.

South London Electric Supply Corporation.

Mr. Geo. Ellis, chairman, presided at the Cannon Street Hotel on Tuesday afternoon over the ordinary general meeting of the shareholders of the above company.

In moving the adoption of the report, the Chairman said he was glad to say there had been a continuance of steady progress. During the past year they had increased the number of lamps connected by over 19,000, and those figures, he thought, spoke for themselves. Since the date of the accounts there had been a steady increase in the number of lamps applied for. Although the number of lamps connected and applied for was not yet 100,000, they would be glad to hear that it was well over 99,000. As they were no doubt aware, the L.C.C. commenced running their electric tramcars in the middle of May last, since which time all the steam power required had been satisfactorily supplied by the company. Now that the company's earning capacity had arrived at a more satisfactory stage, the directors thought that the time had come for dealing with preliminary expenses on a fixed scale. As the matter was of great importance to shareholders, they took counsel's opinion on the point. Counsel had advised that provided adequate yearly provision was made for the payment of these expenses so as to extinguish them within a reasonable period, dividends might be distributed as and when earned. In order, therefore, to give full effect to the opinion of counsel and make particular provision for the liability, the directors had arranged a scale of gradual payments commencing with the sum of £4,020 this year, which would annually decrease the liability, and ultimately extinguish it in 10 years from this date. The electricity generated and sold during the year showed a great increase in the output, the units sold in 1902 being 1,093,029, and for the year ending December 31st, 1903, being 4,805,481. The increase due to their own consumers was 36 per cent. in excess of the sales in 1902, and the balance had been generated by the L.C.C. plant temporarily erected at the works, and to which the company supplied steam under contract. This increase had naturally improved the total cost per unit sold. The coal costs had no doubt been somewhat heavy, which was largely due to the fact of the peak of the traction load having coincided exactly with that of the lighting load each evening, and also to the fact that the greater portion of their units had been turned out non-condensing, and their boiler plant had been severely taxed to cope with the load. The traction supply had to be maintained during the 24 hours each day with a consequence that on light load the plant employed was not very economical. In order to improve the coal costs, they had this year put in operation additional condensing plant, and he was pleased to report that already there was a satisfactory decrease in the cost per unit generated. As next winter's load would require additional boiler plant, they had placed a contract for three more boilers, to be completed and in working order by August next. With regard to the future, he had just heard that their estimated net profit since January 1st last already amounted to more than that made in the first six months of last year, and in face of such a fact they might surely be sanguine of a successful year. Up to that day the net profit amounted to £6,200, as against £5,210 for the first six months of last year. At the end of the year their overdraft amounted to £33,800, which in the early days of January increased to £35,000. In order to liquidate this overdraft, the directors conferred with their broker, who undertook to find £50,000 on debentures bearing 5 per cent. interest, being part of an authorised issue of £100,000. Having regard to the depression in the money market, and not caring to run the risk of a possible failure of a public issue, or of offering the debentures to the shareholders, the directors deemed it in the best interests of the company to close with the broker's offer. These debentures were to bearer with coupons attached, interest at 5 per cent. being payable on April 1st and October 1st, and they were repayable on April 1st, 1907. The company, however, reserved to themselves the right to pay off the bonds at par on, or at any time after October 1st, 1905. Out of the profit available for distribution, the directors recommended a dividend of 3 per cent. for the year.

Captain Bax seconded the adoption of the report.

Replying to questions, the Chairman said the L.C.C. were bound by a contract to them for a minimum period of 18 months and a maximum period of three years. He had no doubt they would run nearly the whole time. Seeing that the period was so short for the debentures, he did not think they could get them at a lower rate than 5 per cent. It would be possible to pay off the preliminary expenses—which stood at £42,000—in less than 10 years if it was thought advisable, but the shareholders would get a smaller dividend.

The report was then agreed to, and the retiring directors re-elected.

Swansea Improvements and Tramways Co.

The directors' report for the half-year ended December 31st, 1903, shows that the gross receipts of the tramways undertaking amounted to £15,486, being an increase of £1,725 upon the corresponding period of last year, and the expenses (including debenture and other interest) to £10,122, an increase of £505. The profit on the half-year's working is £5,364, which, added to the balance of £1,322 brought forward, makes a total of £6,686.

The directors recommend that this sum be allocated as follows:—

Reserve fund, and in reduction of balance of advances due to B.E.T. Co.	£1,000
Dividend on 984 preference shares (6 per cent. per annum)	295
Dividend on 4,016 preference shares (5 per cent. per annum)	1,004
Dividend on 13,000 ordinary shares (2½ per cent. for the year)	3,250
Carried forward to next account	1,137
	£6,686

The construction of the Swansea Corporation tramways and light railways has been commenced by the Corporation. When completed, the lines will be leased to the company. It is anticipated that one section will be opened for public traffic in the early summer.

The working of the Mumbles railways and pier shows a profit of £739, which, deducted from the deficiency of £2,544 for the half-year ended June 30th, 1903, leaves a net deficiency of £1,805 on the year's working. In terms of the agreement this amount is to be provided by the B.E.T. Co. The exceptionally wet weather during the greater part of the year seriously affected the traffic.

	Half-year ended Dec. 31st, 1903.	Half-year ended Dec. 31st, 1902.
Miles open—	M.	M.
Route miles	5·49	5·49
Single line	2·94	2·94
Double line	2·55	2·55
Number of passengers carried	2,896,784	2,560,509
Average receipts per passenger	1·25d.	1·26d.
Average expenditure per passenger	·72d.	·76d.
Proportion of expenses to receipts	58 %	60·5 %
Number of cars in stock	41	41

City of London Electric Lighting Co.

The ordinary general meeting of the shareholders of this company was held on Wednesday at Salisbury House, London Wall, Mr. George Herring, the chairman, presiding.

In proposing the adoption of the report, the Chairman said he hoped that the shareholders would be, to a certain extent, pleased with it. The gross revenue had decreased by nearly £8,000, which was due principally to the competition they had had to face. Despite that reduction, their net revenue had increased by nearly £2,000, which was entirely due to the economies which had been made in the generating expenses. The saving in coal alone had amounted to £7,567, and of that only £1,105 was due to the reduced price; the balance £6,400 being entirely due to the economies which had been effected by Mr. Bailey, the engineer. Even Mr. Bailey himself was surprised at the economies made this year. Each succeeding year he had made economies, and he thought, and they all thought, that they would almost cease; but the results showed that that had not been the case. Turning to the accounts, they had placed £45,000 to the reserve account, and £500 to the leasehold redemption fund. Some shareholder might ask—seeing the accounts were so favourable—why they did not pay an increased dividend. He candidly admitted that they could have done so, bu

what they were anxious to do was to place the company in an unassailable position in view of the severe competition they had to encounter. As they added fresh customers, the company required further plant; also they had to renew their old plant, and, as a matter of fact, in 1901 they spent £41,000 on capital account. Last year they spent £81,000, and this year again they would have to spend a largish sum of money in providing fresh plant and in keeping the old plant in a first-rate condition; and they had done that without issuing one shillingsworth of fresh capital. He thought, therefore, they would look upon it as a wise provision to put aside that £45,000, as that money was used for what he hoped they would consider a most excellent purpose, in keeping their plant in such a condition that they would be able to meet any competition. His belief, and his colleagues agreed with him, was that the future of the company was very hopeful, and he hoped that was the last time he would have to ask them to be content with a 5 per cent. dividend. He was not given to prophecy; but provided that no disaster occurred, he could tell them that the dividend would be increased next year. The average price obtained per unit in 1902 was 4·4d.; last year it had fallen to 3·72d.—that was to say, there had been a reduction of about ⅓d. That did not seem much by itself, but it meant a great deal to them, as it meant a difference of £17,681 in their receipts, equal to a 2½ per cent. dividend. The customers had continued to increase, and the lamps connected had increased by some 66,000. They had sold a little over 600,000 more units than in 1902, and yet Mr. Bailey had produced that increased quantity of energy at a decreased expenditure of £8,000. Mr. Bailey had introduced an arrangement by which those engaged in the generating department received a certain bonus on their salaries according to the amount of saving effected, and that plan had worked exceedingly well. He was pleased to say that they were getting on much more comfortably with the City Corporation, and he hoped there would never be any necessity to go back to the past. They had always been very anxious indeed to be on the best of terms with them, and they showed, to a certain extent, a similar disposition. As regarded the competition of the Charing Cross and Strand Co., he must say that they had fought very fairly and honourably. At the same time, having said that, he did feel that it was a very ridiculous thing that they should go on fighting.

Mr. J. B. Braithwaite, jun., seconded the motion, and the report was adopted.

Hove Electric Lighting Co., Ltd.—The report of the directors for the year ended December 31st states that the net profits have increased from £10,043 in 1902 to £11,215 in 1903. With the balance brought forward from last year and interest on deposits there is a total sum of £11,482 to dispose of. After deducting debenture interest and income-tax paid and accrued, the directors propose to place £3,000 to the credit of the reserve fund account, to place £500 to the credit of the maintenance reserve account, to declare a dividend, payable on April 15th next, at the rate of 10 per cent. per annum for the half-year on the share capital paid up (making with the interim dividend 8½ per cent. for the year) and to carry £250 forward.

Direct Spanish Telegraph Co.—It is proposed to pay in addition to the dividend at the rate of 10 per cent. per annum on the preference shares, a dividend at the rate of 4 per cent., free of income-tax, on the ordinary shares, for the half-year ended December 31st, 1903.

Davis & Timmins, Ltd.—The directors recommend a dividend on the ordinary shares at the rate of 8 per cent. per annum, for the year 1903.

Commercial Cable Co.—Quarterly dividend, 2 per cent.

Stock Exchange Notices.—The Committee has ordered the undermentioned to be quoted in the Official List:—

British Columbia Electric Railway Co., Ltd.—Further issue of £45,000 4½ per cent. Vancouver Power debentures of £100 each, Nos. 1,751 to 2,200.

Edmundson's Electricity Corporation, Ltd.—Further issue of £68,533 4½ per cent. first mortgage debenture stock (redeemable).

New Issue.—The National Telephone Co. has this week been issuing a prospectus inviting subscriptions for an issue of £1,000,000 4 per cent. debenture stock at the rate of £95 per cent. This stock will form part of the authorised 4 per cent. debenture stock of the company, and will rank *pari passu* therewith.

STOCKS AND SHARES.

Wednesday Evening.

Judging from the weakness from which the Stock Exchange is suffering in most of its markets, the pessimist might well see in this depression a reflection of the fears that Europe may be dragged into the Russo-Japanese trouble, after all. Such apprehensions do find vague disciples, the latter all the more ready to be attracted, because of the painful lack of business. The Stock Exchange year ends on March 25th, and it may safely be said that the house has rarely passed through a twelvemonth of such disappointment in all markets.

Of the quartette of rises shown by the price lists on the succeeding pages, three of them occur in the Railway and Miscellaneous section. Central London Preferred has advanced a point, while the other two issues are unchanged. City and South London Ordinary is inclined to be slightly weaker, although no quotable alteration has occurred. Metropolitans and Districts are 83½ and 32½ respectively. In the gilt-edged list, Central London Debenture stands at 111½, a point above the 4 per cent. Debenture of the City and South London. The three Preference stocks of the latter company are quoted 124½, 120½, and 119½ for the 1891, 1896, and 1901 issues respectively.

India-Rubber, Gutta-Percha shares are 10s. better at 19 upon a slight demand, and Telegraph Constructions followed suit with a rise of a pound. Both shares, of course, pay the purchaser well at the present prices, although such a consideration does not go for much in markets nowadays. British Aluminium "A" Preference are 7½, Westinghouse Preference 4, and British Thomson-Houston 4½ per cent. Debenture 102. Willans & Robinsons have been done at 4 this week, and the Preference are 5¼. Babcock & Wilcox Ordinary keep at 2⅞ and 1½ for Ordinary and Preference: it is stated upon good authority that the company is very busy just now. Brush Second Debentures have fallen to 74½, but so far there has been no outburst of disinterested indignation at the iniquity of the dealers in putting down the price. The Preference shares are ¼ lower at 1 middle.

Good reports and evil reports have much the same effect upon the shares in electrical lighting companies. Eleven of the chief London undertakings show increases in their net revenue statements; seven of them pay increased dividends, and yet the only result of a batch of good reports issued this week is a decline in the case of seven shares. Brompton Ordinary have fallen ¼ to 10¼, at which price the return is close upon 5 per cent. The substantial sum of £4,179 is carried forward. Metropolitans remain at 18, and the report is also a good one, showing an increase of 100,000 lamps connected at the end of 1903, as compared with the previous year. The depreciation and reserve fund stands now at £116,477. Nothing new is announced with regard to the Marylebone situation. County of London Preference fell ½ to 11½, and this company's statement met with a satisfaction not altogether unqualified, the terms of the auditors' certificate, hinting that a too liberal allowance had not been made for depreciation. London Electric Ordinary are again ¼ down, to 1½, upon the resolution to create 20,000 new Preference shares of £5 each. South Londons, too, have lost over 5s., at 3½, and so have Charing Cross Ordinary at 7½, although the recent issue of new shares can hardly have anything to do with the fall this time. Kensingtons, at 11, have dropped 10s., and in the Debenture list, Charing Cross 4 per cents. are a point off at 102 middle.

National Telephone stocks are remaining steady under the influence of the new issue, which turns out to be one million pounds of 4 per cent. Debenture stock at 95, which *may* be redeemed at the end of the present year at 105 per cent., but which is likely to run until 1911. Naturally the existing 4 per cent. Debenture has weakened a trifle to par, but none of the other stocks are altered, except the Preferred, which has risen a point, to the level 100. Replying to a question in the House of Commons the other night, Lord Stanley said that the development of the London telephone service by the Post Office will be expedited as soon as funds have been provided under a Bill which he hoped shortly to introduce. He further remarked that the National Telephone Co. were bound to sell their plant in the London area to the Post Office at a valuation on what are known as "tramway" terms when the company's license expires.

Telegraph stocks are neglected, but the Anglo-American group shaded off when rumours went round that the next quarterly dividend on the Preferred might not be paid in full. West India and Panama Debentures have dropped a point to par. Globe Preference at 12¼ are the fraction duller, and the Eastern varieties exhibit virtually no change.

In the Traction department, London United Tramways yielded ¼ to 11¼, and the Debenture has changed hands as low as 101½, although part of the recent opposition to the company's Bill has been dropped. A little business is doing in Potteries Traction Ordinary at about 9. British Electric Traction Preference fell 10s. to 10½, but the Ordinary keep about 9½, although business in the shares is being mostly done beneath that quotation. Anglo-Argentines at 4⅞ and City of Buenos Ayres at 8¾ are quiet, awaiting developments on the "other side." The British Columbia Electric issues display no change beyond a point rise to 97½ in the Preferred Stock.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	Name.	Stock or Share. ‡	Dividends for the last three years. 1901.	1902.	1903.	Closing Quotations March 2nd.	Closing Quotations March 9th.	Business done week ended March 9th, 1904. Highest	Lowest
67,100	African Direct Telegraph, 4 % Debs.	100	..	..	..	98 —102	98 —102	..	..
25,000	Amazon Telegraph Co.'s shares, Nos. 1 to 25,000	10	..	..	..	2⅛— 3⅛	2⅛— 3⅛	..	..
119,700£	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	..	..	..	70 — 80	.. — ..	..	..
788,840	Anglo-American Telegraph	Stock	61s.	60/6	61s.	49 — 52 xd	48 — 51	49	..
3,105,580	Do. do. do. 6 % Pref.	Stock	6 %	6 %	6 %	92 — 94 xd	91 — 93	93	91⅛
3,105,580	Do. do. do. Deferred	Stock	2s.	1/-	2s.	7 — 7⅛xd	7 — 7⅛	7⅛	7
44,000	Chili Telephone, Nos. 1 to 44,000	5	5 %	6 %	..	4⅜— 5⅛	4⅜— 5⅛	..	..
13,333,300$	Commercial Cable	$100	8 %	8 %	..	180 —190	180 —190	..	..
1,841,209	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	..	..	..	89 — 91	89 — 91	91	90
16,000	Cuba Telegraph	10	4 %	6¾%	..	7 — 8	7 — 8	7⅛	7⅛
6,000	Do. 10 % Pref.	10	..	..	..	16 — 17	16 — 17	..	..
12,981	Direct Spanish Telegraph	5	4 %	4 %	..	2⅛— 3⅛	2⅛— 3⅛	..	..
6,000	Do. do. 10 % Cum. Pref.	5	..	..	..	7⅞— 8⅛	7⅞— 8⅛	..	..
30,000	Do. do. 4½ % Debs.	50	..	..	..	98 —101⅝	98 —101 ⅝	..	..
60,710£	Direct United States Cable	20	8½%	8½%	..	9¾ — 10⅛	9¾ — 10⅛	10⅜	9⅞
85,800	Direct West India Cable, 4½% Reg. Deb., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
4,000,000	Eastern Telegraph, Ord. Stock	Stock	7 %	7 %	..	117 —122	117 —122	120	119
1,955,565	Do. 3½ % Pref. Stock	100	..	..	..	87 — 90	87 — 90	8-½	..
1,584,645	Do. 4 % Mort. Deb. Stock Red.	Stock	..	..	..	105 —108	104 —107	104	..
800,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	..	10¾— 11⅛	10¾— 11⅛	11 1/16	10¾
800,000£	Do. 4 % Deb. Stock	Stock	..	..	..	104 —107	104 —107	105	104
800,000	Eastern & South African Tele., 4% Mt. Db., Nos. 1 to 8,000, red. 1909	100	..	..	..	98 —101	98 —101	98½	..
200,000£	Do. do. 4 % Reg. Mort. Debs. (Mauritius Sub.) 1 to 8,000	25	..	..	..	99 —102	99 —102	..	..
180,227	Globe Telegraph and Trust	10	5½%	..	..	8¾— 8¾	8¾— 8¾	8¾	8 15/16
180,042	Do. do. 6 % Pref.	10	..	..	..	12¼— 12¾	12 — 12⅝	12¼	12⅜
150,000	Great Northern Telegraph, of Copenhagen	10	15 %	12½%	..	23⅜— 24½	23⅜— 24½	..	..
58,700	Halifax and Bermudas Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	..	..	..	98 —101	98 —101	..	..
17,000	Indo-European Telegraph	25	10 %	10%	..	38 — 41	38 — 41	38¼	..
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	..	..	..	100 —103	100 —103	..	..
1,988,338	National Telephone, Pref. Stock	100	5 %	6 %	6 %	98 —100 xd	99 —101	100½	98½
1,966,667	Do. do. Def. Stock	100	..	4½%	5 %	73 — 76 xd	73 — 76	74½	73
15,000	Do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14 xd	13 — 14	..	..
15,000	Do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13½ — 14½xd	13½ — 14½	..	..
2,250,000	Do. do. 5 % Non-cum. 3rd. Pref., 1 to 250,000	5	5 %	5 %	5 %	5 — 5⅛xd	5 — 5⅛	5	..
000,000£	Do. do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	95 — 97	95 — 97	95½	94⅛
600,000	Do. do. 4 % Deb. Stock Red.	100	4 %	4 %	4 %	100 —102	99 —101	101	98½
179,313	Oriental Telephone and Elec. Nos. 1 to 171,504, fully paid	1	6 %	6 %	..	⅞— 1	⅞— 1	..	..
50,000	Do. do. do. 6 % Cum. Pref.	1	..	..	..	1 — 1⅛	1 — 1⅛	..	..
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	..	..	..	97 —100	97 —100	..	..
11,889	Reuter's	8	5 %	..	..	6½— 7⅛	6½— 7⅛	7⅛	..
8,808	Submarine Cables Trust	Cert.	..	..	..	115 —120	115 —120	..	..
58,000	United River Plate Telephone	5	7 %	7 %	..	5⅝— 6	5⅝— 6	..	..
40,000	Do. do. 5 % Cum. Pref., Nos. 1 to 40,000	5	..	..	..	4⅜— 5⅛	4⅜— 5⅛	..	..
179,947£	Do. do. 5 % Debs.	Stock	..	..	..	102 —105	102 —105	..	..
15,609	West African Telegraph, Shares	10	..	2 %	..	5 — 6	5 — 6	..	..
150,000£	West Coast of America, 4% Debs., 1 to 1,500 guar. by Braz. Sub. Tel.	100	..	..	..	95 — 98	95 — 98	..	..
267,980	Western Telegraph, Ltd., Nos. 1 to 207,980	10	7 %	7 %	..	11⅜— 12⅛	11⅜— 12⅛	12⅛	12
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	..	..	..	100 —103	100 —103	..	..
400,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	98 —101	98 —101	..	..
88,321	West India and Panama Telegraph	5	..	..	..	⅜— ½	⅜— ½	..	..
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	..	..	..	6 — 6½	6 — 6½	..	..
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	..	..	..	4⅛— 5⅛	4⅛— 5⅛	..	..
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	..	..	..	99 —102	99 —102	..	..

ELECTRICAL RAILWAY, MANUFACTURING AND INDUSTRIAL COMPANIES.

20,000	British Aluminium 7 % Cum. Pref.	10	..	..	..	4 — 5	4 — 5	..	..
800,000£	Do. do. 5 % 1st Mort. Deb. Stock Red.	Stock	..	..	..	87 — 91	87 — 91	..	..
100,000	British Electric Traction	10	9 %	8 %	..	9 — 10	9 — 10	9⅜	9⅛
100,000	Do. do. 6 % Cum. Pref.	10	..	..	..	10⅛ — 11⅛	10 — 11	10⅝	10⅜
600,000£	Do. do. 5 % Perpetual Debenture Stock	Stock	..	..	..	120 —123	120 —123	121½	120½
100,000	British Insulated and Helsby Cables	5	10 %	10 %	..	6 — 6⅛	6 — 6⅛	..	..
100,000	Do. do. 6 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	c 5⅛— 5⅜	..	..
50,000	Do. do. 4½ % 1st Mort. Deb. Red.	100	..	..	..	102 —107	102 —107	..	..
50,000	¶Browett, Lindley & Co., Ord.	£1	Nil	..	..	⅛— ⅜	⅛— ⅜	..	..
50,000	¶ Do. do. 6 % Cum. Pref.	£1	6 %	..	..	14/6 to 15/6	14/6 to 15/6	..	..
105,781	Brush Electrical Engineering, Ord., 1 to 105,781	2	Nil	Nil	..	½ — 1	½ — 1	..	..
150,000	Do. do. Non-cum. 6 % Pref.	2	3 %	6 %	..	1 — 1½	¾ — 1½	..	..
125,000£	Do. do. 4½ % Perp. Deb. Stock	Stock	..	..	..	96 — 99 xd	96 — 99	..	..
125,000£	Do. do. 4½ % Perp. 2nd Deb. Stock	Stock	..	..	..	75 — 80	72 — 77	..	..
35,000	Callender's Cable Construction shares	5	20 %	15 %	..	10½ — 11½	10⅝ — 11½	10½	..
40,000	Do. do. do. 5 % Cum. Pref.	5	..	..	..	5⅛— 5⅜	5⅛— 5⅜	..	..
90,000£	Do. do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	..	..	..	104 —108	104 —108	..	..
1,860,014	Central London Railway, Ord. Stock	Stock	4 %	4 %	4 %	92 — 95	92 — 95	92⅞	..
494,098	Do. do. 4 % Pref. Stock	Stock	4 %	4 %	4 %	97 —100	98 —101	..	..
494,998	Do. do. Def. do.	Stock	4 %	4 %	4 %	86 — 89	86 — 89	..	..
1,880,000	City and South London Railway	Stock	2 %	3½%	2⅝%	49 — 52	49 — 52	49⅞	..
85,000	Crompton & Co., Nos. 1 to 85,000	3	7½%	5 %	..	1⅝— 2	1⅝— 2	..	..
100,000£	Do. 5 % 1st Mort. Reg. Debs., to 900 of £100, and 901 to 11,000 of £50 red.	..	..	..	..	96 — 99	96 — 99	..	..
99,261	Edison & Swan United Elec. Light, "A" shares, £3 paid, 1 to 99,261	5	Nil	Nil	..	0 — ¼	0 — ¼	..	..
17,139	Do. do. "A" shares, 01—017,139	5	Nil	Nil	..	¼— 1⅛	¼— 1⅛	..	..
344,023£	Do. do. 4 % Deb. Stock Red.	100	..	..	..	72 — 77	72 — 77	74	73⅜
100,000£	Do. do. 5 % 2n Deb. Stock Prov. Certs. all pd.	100	..	..	..	76 — 81	76 — 81	..	..
112,100	Electric Construction, 1 to 112,100	2	6 %	6 %	..	1⅛— 1⅜	1⅛— 1⅜	..	..
81,890	Do. do. 7 % Cum. Pref., 1 to 81,890	2	..	..	..	2⅜— 3	2⅜— 3	..	..
82,500£	Do. do. 4 % Perp. 1st Mort. Deb. Stock	Stock	..	..	..	97 —100	97 —100	..	..
25,000	General Electric Co. (1900), 5 % Cum. Pref.	10	5 %	5 %	..	9¼— 9⅜	9⅛— 9⅜	..	..
200,000	Do. do. 4 % Mort. Deb.	Stock	..	..	..	95 — 98	95 — 98	..	..
85,000	Henley's (W. T.) Telegraph Works, Ord.	5	20 %	20 %	15 %	12 — 13	12 — 13	..	..
35,000	Do. do. 4½ % Pref.!	5	..	..	..	5 — 5⅛	5 — 5⅛	..	..
48,050	Do. do. 4½ Mort. Deb. Stock	Stock	..	..	..	106 —110 xd	106 —110	..	..
60,000	India-Rubber, Gutta-Percha & Telegraph Works	10	10 %	10 %	..	18 — 19	18⅛— 19⅛	18 1/16	18 1/16
800,000£	Do. do. do. 4 % 1st Mort. Deb.	100	..	..	..	100 —103	100 —103	..	..
87,500	†Liverpool Overhead Railway, Ord.	10	1½%	1½%	..	4 3/16— 4 5/16	4 3/16— 4 5/16	..	..
10,000	† Do. do. Pref. £10 paid	10	..	..	..	9¼— 10¼	9¼— 10¼	..	..
87,850	Telegraph Construction and Maintenance.	12	20 %	20 %	20 %	33 — 36	34 — 37	36	34½
150,000£	Do. do. 4 % Deb. Bds., Nos. 1 to 1,500 Red. 1909	100	..	..	..	101 —104	101 —104	..	..
540,000£	Waterloo & City Railway, Ord. Stock	100	3 %	3⅛%	3⅛%	88 — 91 xd	88 — 91	88½	..

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise sta.ed all shares are fully paid. ¶ From Manchester Share List.

Bank rate of discount 4 per cent. (September 3rd, 1903).

SHARE LIST OF ELECTRICAL COMPANIES (*continued*).—ELECTRICITY SUPPLY COMPANIES.

Present issue.	NAME,	Stock or Share.	Dividends for the last three years 1901.	1902.	1903.	Closing Quotations March 2nd.	Closing Quotations March 9th.	Business done week ended March 9, 1904. Highest	Lowest
100,000	Blackheath and Greenwich Dist. Electric Light, Ord...	† 1	..	..	..	5/8 — 3/4	5/8 — 3/4	..	..
50,000	Do. 7 % Pref.	1	..	..	..	1 1/8 — 1 1/4	1 1/8 — 1 1/4	..	..
100,000	Do. 4½% 1st Deb. Stock, Prov. Certs. ..	100	..	..	..	115 — 118	115 — 118	..	..
20,000	Brompton & Kensington Electric Light Sup., Ord., 1 to 20,000 ..	5	8 %	8 %	10 %	10 1/4 — 10 3/8	10 — 10 3/8	10 1/2	..
20,000	Do. do. 7 % Cum. Pref. ..	5	..	..	..	9 3/4 — 10 1/4	9 3/4 — 10 1/4	..	..
250,000	Central Electric Supply 4 % Guar. Deb. Stock	100	..	..	..	106 —109	106 —109	..	..
50,000	Charing Cross and Strand Electricity Supply	5	10 %	10 %	8 %	7 3/8 — 8	7 3/8 — 7 3/4	7 1/2	7 7/16
70,000	Do. do. do. 4½% Cum. Pref. ..	5	..	..	..	5 1/8 — 5 1/4	5 1/4 — 5 3/8	..	..
40,000	Do. do. "City Undertaking" 4½% Cum. Pref. ..	5	..	..	..	4 1/2 — 5	4 1/2 — 5	..	..
40,000	Do. do. 1903	5	..	..	..	4 1/2 — 5	4 1/2 — 5	..	..
250,000	Do. do. 4 % Deb. Stock Red.	100	..	..	..	102 —104	101 —103	102	..
44,496	*Chelsea Electricity Supply, Ord.	5	4 %	4½%	5½%	5 1/2 — 6	5 1/2 — 6	..	..
150,000‡	Do. do. % Deb. Stock Red.	Stock	..	..	..	106 —109	106 —109	..	..
70,595	City of London Electric Lighting, Ord. 40,001—110,595 ..	10	5 %	5 %	5 %	10 3/4 — 11 1/4	10 3/4 — 11 1/4	11 1/8	10 3/4
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	..	..	..	13 — 14	13 — 14	13 3/8	..
400,000‡	Do. 5 % Deb. Stock, Scrip. (iss. at 115) all paid	..	..	..	..	121 —126	121 —126	..	..
300,000	Do. 4½% 2nd Deb. Stock, Prov. Certs., all paid	100	..	..	..	101 —104	101 —104	..	..
40,000	County of London & Brush Prov. Electric Lighting, Ord. 1—40,000..	10	4 %	4 %	4 %	7 1/2 — 8 1/2	7 1/2 — 8 1/2	7 3/4	..
20,000	Do. do. do. 6 % Pref., 40,001—60,000..	10	..	..	..	11 3/4 — 12 1/4	11 — 12	11 1/4	..
400,000‡	Do. do. 4½% Deb. Stock	..	..	..	..	106 —109	106 —109	..	..
250,000	Do. do. 4½% 2nd Deb. Stock	Stock	..	..	..	99 —102	99 —102	..	..
50,000	Edmundson's Electric Corporation, Ord. Shares	5	7 %	7 %	..	5 3/8 — 6 1/2	5 1/2 — 6 1/2	..	..
30,000	Do. do. 6 % Cum. Pref.	..	..	..	..	5 3/8 — 6 1/2	5 1/2 — 6 1/2	..	..
140,000	Do. do. 4½% 1st Mort. Deb. Stock ..	100	..	..	..	103 —106	103 —106	..	..
21,000	Kensington and Knightsbridge Electric, Ord.	5	10 %	10 %	12½%	11 — 12	10 3/4 — 11 1/4	..	..
90,000	Do. do. do. 4 % Debenture Stock ..	Stock	..	..	..	103 —106	103 —106	105	103 3/4
110,000	London Electric Supply Corporation, Limited, Ord.	3	..	..	..	1 3/4 — 2	1 3/4 — 1 7/8	..	..
49,840	Do. do. do. 6 % Pref.	5	..	..	..	4 1/2 — 5 1/2	4 1/2 — 5 1/2	5	4 13/16
250,000‡	Do. do. do. 4 % 1st Mort. Deb. Stock Red	Stock	..	..	..	95 — 98	95 — 98	97 1/2	..
100,000	Metropolitan Electric Supply, 1 to 100,000	10	6 1/4%	7 1/2%	8 3/4%	17 1/2 — 18 1/2	17 1/4 — 18 1/4	18 1/4	17 1/2
71,106	Do. do. 4½% Cum. Pref. 1—71,106, £3 paid ..	5	..	..	..	5 1/8 — 5 3/8	5 1/4 — 5 3/8	5 1/4	5 3/8
220,000‡	Do. do. 4½% 1st Mort. Deb. Stock	..	..	..	..	109 —113	109 —113	110	..
250,000‡	Do. do. 3½% Mort. Deb. Stock Red	Stock	..	..	..	95 — 98	95 — 98	96 1/2	95
10,852	Notting Hill Electric Lighting	10	6 %	6 %	6 %	13 — 14	13 — 14	..	..
50,000	Do. do. 4 % First Mort. Debs.	100	..	..	..	99 —102	99 —102	..	..
40,000	St. James' and Pall Mall Electric Light, Ord.	5	14½%	14½%	14½%	14 — 15	14 — 15	..	..
20,000	Do. do. do. 7 % Pref. 20,081 to 40,080	5	..	..	..	8 — 9	8 — 9	..	..
150,000‡	Do. do. do. 3½% Deb. Stock Red ..	100	..	..	..	97 —100	97 —100	..	..
12,000	Smithfield Markets Electric Supply, Ord.	5	..	2½%	4 %	3 — 3 1/2 xd	3 — 3 1/2	..	..
50,000	Do. do. do. 4 % Deb. Stock	Stock	..	..	..	85 — 90	85 — 90	..	..
65,000	South London Electricity Supply, Ord.	5	..	1½%	3 %	3 1/4 — 4	3 1/4 — 3 1/2	3 5/16	..
80,000	Urban Electric Supply, Ord.	5	..	..	..	4 1/2 — 5	4 3/8 — 5	..	..
80,000	Do. do. 5 % Cum. Pref.	5	..	..	..	4 1/4 — 5 1/8	4 1/4 — 5 1/8	4 5/16	..
110,000	Westminster Electric Supply, Ord.	5	10½%	12 %	13½%	12 1/4 — 13 1/4 xd	12 1/4 — 13 1/8	13 1/16	12 13/16
28,141	Do. do. 5 % Cum. Pref.	5	..	..	..	6 — 6 1/2	6 — 6 1/2	..	..

* Subject to Founders Shares. † Unless otherwise stated all shares are fully paid.

MARKET QUOTATIONS, Wednesday, March 9th.

	CHEMICALS, &c.		Latest Price.	Week's Inc. or Dec.
a	Acid, Hydrochloric	per cwt.	5/-	..
a	" Nitric	per cwt.	22/-	..
a	" Oxalic	per cwt.	32/-	..
a	" Sulphuric	per cwt.	5/6	..
a	Ammoniac, Sal	per cwt.	42/-	..
a	Ammonia, Muriate (crystal) ..	per ton	£33 10	..
a	" "	per ton	£30	..
a	Bleaching powder	per ton	£4 10	..
a	Bisulphide of Carbon	per ton	£15	..
a	Borax	per ton	£18	..
a	Benzole (90 %)	per gal.	7/-	..
a	" (50/90 %)	per gal.	5/6	..
a	Copper Sulphate	per ton	£23	..
a	Lead, Nitrate	per ton	£24	..
a	" White Sugar	per ton	£31	..
a	" Peroxide	per ton	£27 10	..
a	Methylated Spirit	per gal.	2/6	..
a	Naphtha, Solvent (90% a 160° C).	per gal.	5/6	..
a	Potash, Bichromate, in casks ..	per lb.	3d.	..
a	" Caustic (75/80%).. ..	per ton	£24	..
a	" Bisulphate	per ton	£35	..
a	Shellac	per cwt.	205/-	5/- inc.
a	Sulphate of Magnesia	per ton	£4 10	..
a	Sulphur, Sublimed Flowers ..	per ton	£6 10	..
a	Recovered	per ton	£5 10	..
a	" Lump	per ton	£5	..
a	Soda, Caustic (white 70 %) ..	per ton	£10 15	..
a	Crystals	per ton	£3	..
a	Bichromate, casks.. ..	per lb.	2½d.	..
	METALS, &c.			
b	Aluminium Ingots, in ton lots ..	per ton	£130	..
b	" Wire, in ton lots ..	per ton	£168	..
b	" Sheet, in ton lots ..	per ton	£166	..
n	Babbitt's metal ingots	per ton	£43 to £130	..
c	Brass (rolled metal 2" to 12") basis	per lb.	6 3/4d.	..
c	" Tube (brazed)	per lb.	8 3/4d.	..
c	" " (solid drawn).. ..	per lb.	7 1/4d.	..
c	" Wire, basis..	per lb.	7d.	..
c	Copper Tubes (brazed)	per lb.	9 1/2d.	..
c	" " (solid drawn) ..	per lb.	9 1/2d.	..
g	Copper Bars (best selected ..	per ton	£70	..

	METALS, &c. (*continued*).		Latest Price.	Week's Inc. or Dec.
g	Copper Sheet	per ton	£70	..
g	" Rod	per ton	£70	..
e	" (Electrolytic) Bars ..	per ton	£62	£1 dec.
e	" " Sheets ..	per ton	£78	£5 inc.
e	" " Rod	per ton	£74	£1 dec.
e	" " H.C. Wire	per lb.	7 3/8d.	1/8d. dec.
f	Ebonite Rod	per lb.	3/8	..
f	" Sheet	per lb.	8/-	..
n	German Silver Wire	per lb.	1/6	..
h	Gutta-percha fine	per lb.	8/-	..
h	India-rubber, Para fine	per lb.	4/5 to 4/5 3/4	..
i	Iron, Charcoal Sheets	per ton	£18	..
i	" Pig (Cleveland warrants)	per ton	42/6	..
i	" Forgings, according to size	per ton	From £11	..
i	" Scrap, heavy	per ton	47/6 to 50/-	..
i	" Wire, galvanised No. 8 ..	per ton	£9 15	..
g	Lead, English Ingot	per ton	£12 5 to £12 7 6	2/6 inc.
g	" " Sheet	per ton	£13	..
m	Manganin Wire No. 28	per lb.	8/-	..
g	Mercury	per bot.	£8 5	..
d	Mica (in original cases) small ..	per lb.	4d. to 1/6	..
d	" " " medium	per lb.	2/6 to 3/9	..
d	" " " large ..	per lb.	4/- to 7/9	..
p	Phosphor Bronze, plain castings	per lb.	1/- to 1/2½	..
p	" rolled bars & rods	per lb.	1/- to 1/3	..
p	" " strip & sheet	per lb.	From 1/1	..
o	Platinum	per oz.	£4	..
p	Silicium Bronze Wire	per lb.	9d. to 11d.	..
i	Steel, Magnet, acc'd'g to desc'p'n	per ton	£58	..
i	" " in bars		£15 to £40	..
g	Tin, Block	per ton	£126 10 to £127 10	..
g	" Foil	per lb.	1/6	..
n	" Wire, Nos. 1 to 16	per lb.	1/7	1/2d. dec.
p	White Anti-friction Metals— "White Ant" brand ..	per ton	£42 to £62	..
j	Yarns, 2/10s Grey Cotton, on sp'ls	per lb.	8d.	..
j	" 6 lea. Flax	per lb.	5 3/4d.	..
j	" 8 ply 10 lbs. Russian ..	per lb.	4 1/4d.	..
j	" 10 lbs. Russian, single ..	per lb.	4 1/2d.	..
j	" 180 lbs. Jute rove ..	per ton	£11	..
k	Zinc, Sh't (Vieille Montagne bnd.)	per ton	£24 15	..

Quotations supplied by Messrs.:—*a* G. Boor & Co.; *b* The British Aluminium Co., Ltd.; *c* Thos. Bolton & Sons., Ltd.; *d* F. Wiggins & Sons.; *e* Frederick Smith & Co.; *f* India-Rubber, G.P. and Teleg. Works Co., Ltd.; *g* James & Shakspeare; *h* Edward Till & Co.; *i* Bolling & Lowe; *j* Walter H. Hindley and Co., Ltd.; *k* Morris Ashby, Ltd.; *m* W. T. Glover & Co., Ltd.; *n* P. Ormiston & Sons; *o* Johnson, Matthey & Co., Ltd.; *p* The Phosphor Bronze Co., Ltd.

ELECTRIC TRAMWAY AND RAILWAY TRAFFIC RETURNS

	Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
	Aberdeen	Mar. 5	1,104	+268	40	48,431	+ 9,569	10	—
	Birmingham ..	" 5	4,507	—187	10	50,791	+ 2,710	3 1/4	—
	Bournemouth ..	" 2	784	— 53	48	48,745	—	10 1/2	—
	Blackburn	" 4	698	+ 14	—	40,962	+ 2,119	13 1/2	—
	Blackpool	" 3	277	— 85	48	40,493	— 291	8 1/2	—
	" —Fleetw'd	" 5	200	— 1	10	1,729	— 82	7 1/2	—
	" —Lytham	" 3	141	—	18	2,687	+ 2,058	7 1/2	—
	Bolton	" 6	1,531	— 84	49	88,279	+ 8,898	25	—
	Bradford	" 6	3,238	— 95	47	181,706	+35,586	78	+1
	Brighton	" 6	653	— 81	—	43,382	—	7 1/2	—
	Bristol	" 4	4,198	— 14	—	—	—	28	—
Br'tish Elec. Trac. Co.	Devonport ..	Feb. 26	423	+ 66	8	3,658	+ 629	5	—
	Dudley—Sto'rb'ge	" 26	760	+ 74	8	5,848	+ 372	18 3/4	—
	Gateshead ..	" 26	833	+ 3	8	6,965	+ 452	10 1/2	+ 1/2
	Gr'n'k—Pt. Glsgw	" 26	416	+ 36	8	3,753	+ 598	7 1/4	—
	Hartlepool ..	" 26	236	+ 15	8	1,977	+ 270	6 1/2	+2
	Middleton.. ..	" 26	236	+ 37	8	1,936	+ 186	8 1/2	—
	Oldham—Ashton	" 26	473	— 29	8	3,927	— 172	8	—
	Potteries	" 26	1,625	+ 64	8	12,983	+ 992	28 3/4	—
	Southport	" 26	217	+ 15	8	1,896	+ 215	5 1/2	—
	South Staffs. ..	" 26	718	+ 9	8	5,854	+ 443	21 1/2	— 1/2
	Swansea	" 26	448	+ 11	8	3,768	+ 206	5 1/2	—
	Wolverhampton..	" 26	832	— 22	8	2,630	— 67	10 1/2	+8
	Yorks. Wool Dist.	" 26	514	+387	8	4,002	+ 809	6	—
	Miscellaneous ..	" 26	1,745	—	8	12,421	—	—	—
	Burnley	Mar. 5	†81	+214	—	—	—	10 3/4	+3 1/2
	Burton-on-Trent ..	" 6	275	—	31	10,553	—	8 1/2	—
	Cardiff	Feb. 27	1,779	+188	—	93,389	+22,961	1	—
	Chatham & District	Mar. 3	443	+ 35	9	4,451	+ 907	8-53	—

* Compared with the corresponding period of 1903.

	Locality.	Week ending	Receipts for the week. £	£*	No. wks.	Total to date. £	£*	Miles open.	*
	Cork	Mar. 3	355	— 89	9	3,472	— 42	9	—
	Dover	" 5	151	— 32	9	1,581	— 105	3	—
	Dublin	" 4	4,072	—132	10	39,257	+ 957	47	+ 1/2
	East Ham	" 7	557	+ 77	—	33,022	+ 2,655	5	+ 1/2
	Glasgow	" 5	12,907	+778	40	543,403	+54,128	69 1/2	+5 1/2
	Halifax (2 weeks) ..	Feb. 24	2,113	— 29	47	62,295	+ 6,275	31 1/2	+1 1/2
	Huddersfield ..	Mar. 5	1,079	+ 34	—	—	—	—	—
	Hull	" 5	1,954	+268	49	93,538	+ 7,548	13	+2
	Ilkeston	" 2	120	—	—	—	—	3 1/2	—
	Ipswich	" 5	272	—	—	4,445	—	9	—
	Isle of Thanet ..	" 5	190	— 65	9	1,921	— 196	10 1/2	—
	Leeds	" 5	4,628	—108	—	264,446	+15,403	41	—
	Liverpool	Feb. 27	9,203	+234	9	85,318	+ 3,119	108	—
	London C. C. ..	Mar. 5	9,189	+1224	48 1/2	477,589	+88,195	39 3/4	—
	Manchester	" 5	10,422	+2380	—	562,602	+285,861	72	—
	Newcastle	" 5	3,396	+400	—	—	—	17	—
	Portsmouth	" 5	1,285	+ 25	—	88,290	+ 5,218	14 1/2	—
	Salford	Feb. 29	3,511	+678	—	182,354	+50,347	30	—
	Sheffield	Mar. 6	3,939	—168	49 1/2	222,536	+18,671	32 1/2	+4 1/2
	Southampton ..	" 3	784	— 64	—	—	—	25 1/2	—
	Southend-on-Sea ..	" 2	172	— 13	48	14,798	+ 2,242	8	—
	Sunderland	" 6	1,017	+ 46	49	58,553	+ 2,794	20	+3
	Tyneside	" 2	269	+ 36	9	2,429	+ 478	8-9	+-43
	Wolverhampton ..	" 6	354	— 57	—	—	—	5 1/2	—
	Cen. London Rly...	" 5	7,248	+270	10	70,365	+ 750	6	—
	City & S. Lon. Rly.	" 6	3,285	+ 47	10	32,176	— 539	6 1/2	—
	Dublin—Lucan Rly.	" 6	77	— 5	10	857	+ 56	6 1/2	—
	L'pool Overh'd Rly.	" 6	1,449	— 45	10	15,143	+ 311	6 1/2	—
	Mersey Railway ..	" 5	1,359	+347	9	12,803	+ 3,157	4 1/2	—

INSTITUTION OF ELECTRICAL ENGINEERS.

THE MERSEY RAILWAY—MULTIPLE CONTROL.

By H. L. Kirker.

(*Abstract of Paper read at Manchester, March 1st, 1904.*)

The Mersey Railway Co. was inaugurated by Act of Parliament in the year 1866, the experimental heading begun in 1879, the permanent work started in 1881, and the road opened for traffic on June 20th, 1886. The contract with the British Westinghouse Electric and Manufacturing Co., Ltd., for the complete electrification of the road was signed on July 15th, 1901, and electric traction was inaugurated on May 3rd, 1903.

Arrangements were made for an instantaneous and complete transformation. The steam traffic was to cease with a certain day, and electric traction, with a complete train service, to begin on the succeeding morning.

On the night of May 2nd all the steam stock was rolled away. During the forenoon of May 3rd (Sunday) the plant was operated for an inspection by the Mersey and Westinghouse officials, representatives of the various sub-contractors and members of the Press. After this inspection the service was thrown open to the public, and electric traction with a three-minute schedule accordingly inaugurated.

This is the first example, on the part of a railway system, of an instantaneous change from steam operation to electric.

The three-minute schedule thus inaugurated has been successfully maintained. This, in the light of the facts that 250 men are more or less directly concerned in the operation of these trains, and 90 per cent. of these men are old steam employés, that these trains are operated in a tunnel, and that 750 trains per day pass through Hamilton Square Station, speaks well for the simplicity of electric traction and the adaptability of the men that have come into contact with it.

[The power station and electrical equipment were described in our issue of May 22nd, 1903.—Eds.]

The ventilation of the tunnel is now entirely satisfactory. The steam plants have been suppressed, and two 12 ft. and one 5 ft. motor-driven fans installed. However, the natural ventilation of the tunnel is such that the 5 ft. fan is seldom required, and the greater part of the work is done by one 12 ft. fan.

The trains are operated on a three-minute schedule, which calls for nine trains in service and two standing by.

The trains vary in size from two to five cars. In the three, four and five-car trains there are two motor-cars, which are situated at the extremities. It was intended to run a three-minute schedule for rush hours only, but the railway company decided to maintain it during the whole traffic period. Accordingly, Mr. J. Shaw, resident engineer of the Mersey Railway, secured the necessary Board of Trade permission to add controlling gear to trailer platforms. This arrangement has advantages in the case of the Mersey. The three-minute schedule required 18 motor-cars out of 24, and trailer cars according to the traffic. As the traffic has two decided peaks per day, there is a considerable amount of building up and cutting down of trains. Consequently, the ability to uncouple a four-car train in the middle, and make two two-car trains of it during light traffic, admits of the three-minute schedule with fewer cars, diminishes the wear on the rolling-stock, and increases the time available for inspection.

The driver's compartment is lined with $\frac{5}{16}$-in. asbestos slate. All cables have non-combustible insulation; the motor leads are carried in iron tubing; the car bottom directly over the motors, rheostats and cables is lined with the same asbestos slate. In addition to the circuit-breaker in the driver's compartment, there is a fuse on each shoe beam. The power cables are confined exclusively to the motor-cars. The control line for the electro-pneumatic control circuits connecting the front and rear motor-cars, is independent of the power circuit, and gets its current from a 14-volt storage battery. All the trains are provided with fire extinguishers.

Electric traction is the natural solution for short hauls and dense traffic. The strong points of the system are cheap power and efficient application. In the case of the Mersey Railway, the coal handling arrangement, the feed-water system, and the storage battery are important elements in the production of cheap power. The efficient application of this power is secured (1) by the location of the power house at a point where the losses in conductors and the investment in cables are a minimum, (2) by the use of multiple-unit train control, which prevents extravagance in the use of power.

The mechanical conveyor and stoker handle 480 tons of coal per week. The time of 11 men is charged against this work. The operation and maintenance charges, including the ash handling, do not exceed £20 per week. It is estimated that if the mechanical work were done by hand, 20 men would be required, and the corresponding charges would be £39, a little less than double the present cost. The effectiveness of the Roney stokers is also attested by the fact that there has not been a single smoke summons since the first few weeks of electrical working.

The use of a surface condenser and a feed-water purifier enables the condensed steam to be returned to the boilers. The average electrical load on the station is 22,000 kw.-hours per day. At 23 lbs. of water per kilowatt-hour, this means 506,000 lbs., or 50,600 gal. per day. Now, since the auxiliaries exhaust into the jet heater and the condensation in the 160 lbs. steam lines is returned to the boilers, the assumption can be made that about 9 per cent., or 4,600 gal. of make-up water is used per day. The cost of purifying is taken at 1d. per 1,000 gal., and the cost of city water at 7d. The net result, therefore, is a saving of 46,000 gal. per day at 6d. per 1,000 gal., which means £420 per year. The discharge from the neighbouring pumping station supplies tunnel water for condensation purposes.

The combined use of the condensation, jet heater and economiser effects a saving in fuel. According to readings, taken a few days ago, the actual difference in temperature between the make-up water going into the hot-well and the feed water going into the boilers was 148° F. Now, as indicated above, the average electrical output of the station means 506,000 lbs. of water per day. To this must be added 250,000 lbs. per day for the pumping station, making a total of 756,000 lbs. of water evaporated every 24 hours. Since this water enters the boiler at a temperature 148° above the borough supply, it follows that 756,000 lbs. of water have been raised 148°, which means that 112,000,000 heat units have been added to the feed water by the condensation, jet heater and economiser. Allowing 12,000 B.T.U. per pound of coal and 65 per cent. for the all day efficiency of the boilers, then 7,800 heat units of every pound of coal consumed get into the steam through the boiler. It is evident, therefore, that the 112,000,000 units absorbed from the condensation, and the gases represent a saving of 14,360 lbs. or 6·4 tons of coal per day. Since the average consumption is 54 tons per day, the saving is practically 11·8 per cent. With coal at 10s. per ton, this means that the saving would more than pay for the economiser in one year.

The booster group consists of a 2,000-ampere reversible shunt booster, a compound-wound exciter, and a 150-h.p. compound-wound driving motor. The booster armature is in series with 320 cells of type R Chloride accumulator of 1,000 ampere-hours capacity at one hour rating, and capable of supporting 2,000 amperes momentary discharge. The battery (with its booster) operates in parallel with the main generators.

During the greater part of the day, one dynamo and the battery are able to carry the load. The average week-day load is 25,000 kw.-hours per day, or an average of 1,280 kw. for the 19½ hours of actual service. This average load exceeds slightly the capacity of one generator. During the ordinary traffic the line load varies rapidly, and may pass from zero to 3,500 amperes in the space of a few seconds. However, the action of the reversible booster is such that the battery discharges into the line during the peaks, and is charged when the line load is light. The result is that the load on the engine is fairly uniform, and is slightly less than full load. This, of course, is an economical running condition. During the heavy traffic the line load ranges from zero to 5,000 amperes. A second generator is used during these periods. The action of the booster is such as to keep both machines working fairly uniformly at about two-thirds of their capacity. (In addition to the charging the batteries get when two main generators are running, they also get a complete charging once a week after traffic hours.)

The above-mentioned features are common to many power stations, and consequently, from an engineering standpoint, are secondary in interest to the most striking electrical feature of the system—the multiple unit train control.

There are several distinct types of auxiliary control, but the fundamental idea is the same in each, *i.e.*, independent motor-car units and centralised control.

On the Mersey Railway the electro-pneumatic drum type is used. It is especially suited to the conditions, for, while the service is severe, due to steep grades, high average speed, and heavy trains (a loaded five-car train weighs 135 tons), the maximum current taken by any one motor-car does not exceed the capacity of a drum type of controller that can be easily installed in the driver's compartment—a location convenient for inspection. Air brakes being used, the storage reservoir for the brakes furnishes the necessary air supply. A 14 volt storage battery current is used on the auxiliaries, consequently the electro-magnets and multiple control switches are simple and robust, and the fire hazard has been eliminated from this part of the apparatus. No bus lines run through the train, so that the recent Board of Trade ruling on this point for underground trains was anticipated.

A limit switch locks the operating cylinder of the controller when the starting current becomes excessive. Its coil is connected in shunt across the field of one motor; accordingly, when the motor current exceeds a certain amount, the drop across the motor fields is sufficient to send a working current through the limit coil, As soon as the motor current falls to the required limit, the switch opens.

On a line where the distances between stations are short, the train intervals brief, the trains heavy, and grades numerous, the starting current can easily become the determining feature of the station load. Rapid acceleration, of course, is indispensable, but without some such restraining device as the limit switch, the starting current can be pushed to such an extreme as to waste power, and subject the motors to damaging overloads.

The main controller and circuit breaker are standard apparatus that have long since been perfected. The auxiliaries constitute the novelty, and at the same time they represent the final development of one type of control. As it now stands, it is simple, safe, automatic, and complete, and has been summed up as "doing its own thinking."

Brief reference will here be made to a later system of electro-pneumatic control, a type in which the revolving drum has been replaced by a group of circuit-breaking switches. This later type, known as the Westinghouse turret system, is not only adapted to the work done by the electro-pneumatic drum type, but is especially suited on account of its lightness and compactness to heavy work—work which would call for a drum controller of such a weight as to prohibit its being mounted on a passenger car. The turret construction is peculiarly adapted to magnetic blow-out, and therefore its arc-breaking capacity is enormous. In a test of this apparatus three 1,500-kw. rotaries were short circuited through one of these controllers, and the resulting current of 18,000 amperes successfully and repeatedly broken by it. It can be mounted either in the

driver's compartment or under the car, but its construction well adapts it to the under-car mounting.

The current breaking switches grouped radially are closed by air pistons working against powerful springs. The cylinders are drilled in the common air reservoir ring casting.

There is the same absence of fire hazard in the auxiliary gear that there is in the Mersey type, as 14-volt storage battery current is used to work the electro-magnets that control the valves. The safety and interlocking features are retained, and the main circuit breakers can be thrown from any master controller in the train.

Results.

It is now practically ten months since electric traction was inaugurated, May 3rd, 1903, consequently sufficient time has elapsed to get a fair idea as to how the results of operation correspond with the original engineering estimates.

First as to ventilation. Under steam conditions the average cost per half-year exceeded £2,400; with electric traction it falls below £200 for a corresponding period, which is well within the estimated figure.

As to the schedule speed, the rate was 15 miles per hour for the steam trains, and electric traction was laid out on the basis of 20 miles per hour, which is attained.

With the steam locomotives the train mileage was less than 6,000 per week. During the last quarter of 1903 the electric trains lacked but 40 miles on an average of 15,000 miles per week. At this rate the total mileage for the year will considerably exceed the original estimate.

Concerning the coal consumption, it was estimated that the average would not exceed 4 lbs. per KW.-hour at the switchboard. The average for the last quarter of 1903 and the first six weeks of this year is under 4 lbs.

The consumption of energy for a loaded three-car train was estimated not to exceed 9·25 KW.-hours per train-mile. For the last quarter of 1903 the actual figure was less than 9.

As regards the cost of operation per train-mile, it was estimated that the power house expenses, the cost of power for operating and lighting trains, the maintenance of electrical equipments, cars and collector rails would not exceed 6·75d. per train-mile for an average train, 230 ft. long, and weighing 105 tons, including motors. The figure for the last quarter of 1903 falls below this estimate. The corresponding cost per steam train, 200 ft. long and weighing 77 tons, exclusive of locomotive, but working at a schedule speed of 15 miles per hour instead of 20, exceeded 11d. per train-mile. It took an 80-ton locomotive to haul the 77-ton steam train.

The total power station cost, made up of maintenance and operation (coal, water, oil, waste, sundries, labour), did not exceed ·35d. per KW-hour during the last quarter of 1903.

From this it appears that the results of operation practically agree with the original engineering estimates.

Discussion.

Mr. Pearce stated that the Central London Railway Co. originally propelled their trains with gearless locomotives having motors of 450 H.P. on each axle. The road bed was of solid concrete, the vibration consequently being taken up by the locomotives, which very often came to grief. Geared locomotives, he stated, give much better results, and the old gearless locomotives are now dispensed with. The multiple-unit system was of great advantage.

Dr. Bowman said that the load diagrams showed the great value of accumulators where the load was of a varying nature. It had been said that accumulators were going out, but he thought they had come to stay.

Mr. J. Shaw (resident engineer to the line) in some remarks on the actual working, stated that a great saving had accrued from ventilation alone, the cost under steam traction being £5,000 per annum, while, under electric traction, the cost would not exceed £200. The receipts, which were originally about £1,000 per week, had now increased to between £1,300 and £1,350. Now that the public had gained confidence in the service, he anticipated a still further increase.

Messrs. Moore and Schoepf also spoke.

A hearty vote of thanks was accorded to the author.

ENERGY DISTRIBUTION TO SUB-STATIONS.

By C. A. Smith.

Discussion at Birmingham, January 27th, 1904.

The chairman, Mr. J. C. Vaudrey, in thanking Mr. Smith for his extremely able paper, said that when the Birmingham Corporation took over the electric supply in 1900, and even prior to that, it seemed to him that there was a case, if it were possible to obtain satisfactory gas engines, for a common ground of working. In a town like Birmingham the gas department's premises occupied huge areas; they were located in districts where people were already accustomed to nuisance, noise and the general mess attending large gas works, and therefore it would seem almost an ideal place to put down machinery or to utilise some portion of the land for electric distribution if such were practicable. He thought even to-day the question was whether a gas engine of sufficiently large size was obtainable or was going to be obtainable. In his costs, Mr. Smith had assumed somewhat low figures, he thought, both in the capital charge and the cost per unit. The number of units assumed by Mr. Smith as possible for a town of the size of Birmingham was exceedingly large. Glasgow at the present moment was reported to be using only 14 million units for tramway purposes, and the total in Liverpool for both lighting and tramways was not more than 24 million units.

Prof. Threlfall said that as far as the estimate of the gas making went, none of them yet had any experience of anything like a 20,000-H.P. station, and these estimates at best were only a sort of pious hope as to what might be accomplished under such conditions. Mr. Humphrey gave a series of figures based on coal of a certain calorific value, which would yield 80 to 90 per cent. of sulphate of ammonia per ton. He was afraid Mr. Smith was taking the coal which the Birmingham Canal Co., could deliver at Smethwick, as comparing with Mr. Humphrey's coal costing say, 5s., and if so that vitiated the whole thing. Those who had had to work with producers unfortunately knew well that the quantity and quality of the gas fell off amazingly as the quality of the fuel diminished. He had known coal companies able to produce a kind of coal which was poorer than the Mond producer could burn. The cost of the Mond producer was extremely high, and it was not economically possible to burn any sort of rubbish. Again, if the coal were poor, it gave rise to great irregularity in the burning; holes were blown through, and the ammonia lost. Mr. Smith had taken the figure of 70 cb. ft. of gas per B.H.P. for gas engines. He was afraid that was another pious hope. On a trial they would get those figures, but they would not get anything like them on continuous running. If they left the engine alone for an hour, and a little grit got into one of the valves, they might often get well over 100 for an engine that ought only to be taking 70. He had not been able to agree with Mr. Smith's conclusions, but he thoroughly appreciated the ability and care shown in the paper.

Mr. Chattock (City electrical engineer) agreed with the author that gas engines were certainly not any good for driving alternators. They did not run steadily enough, and he thought it would be a considerable time before they would be made to do so. Mr. Smith mentioned the variation of 1 in 120 which could be obtained in the large engine he described with a fly-wheel of 40 tons in weight. He should not be inclined to adopt a greater variation than 1 in 200, and he knew as little as 1 in 300 could be easily obtained on the steam engine. He also thought that gas engines of large power were hardly suitable for direct current working when there were several machines running in parallel together on one circuit, as, owing to the danger of back-firing, there was a liability to throw the load off one engine momentarily and overload the other on the circuit, which might have very serious results. As he had been working for some time at the calculations as to the load that might be expected in the city of Birmingham, it might be of interest to give his estimates alongside those of Mr. Smith. In his opinion the supply of 500 cars mentioned under the heading of traction was too high. Probably 150 cars would be nearer the mark, considering that the outlying districts would be supplied from independent stations. That meant that the average load on the traction supply would be about 3,600 KW., instead of 5,000 KW., as estimated. Under the heading of lighting, he thought the estimate was a low one. They already had connected to their mains 172,000 lamps, and there was a very large area of the city that was not supplied. As regarded motor load, he thought 8,000 KW. was about correct. Turning to Mr. Smith's comparison of the two schemes, Mr. Chattock gave calculations in elaboration of his contention that Mr. Smith's estimates were too low, the result he arrived at being that the total cost would be ·768d. per unit sold at sub-station switchboard. This figure was a good one, he admitted, but in his opinion it could be approached, if not equalled, by well designed steam generating plant. With Mr. Earle's estimate of £8 4s. per KW. for steam engines, generators and exciters for a 30,000-I.H.P. plant, it was interesting to compare estimates which he (Mr. Chattock) had recently got out for Birmingham, which amounted to £8 18s. per KW.

Mr. Taylor said the first thing that struck one about this gas supply system was its inflexibility. Mr. Smith had estimated a main of 1¼ ft. diameter, and that was for only one sub-station. There were five sub-stations in the scheme proposed; consequently they had to consider emanating from the central generating station five such mains, each of 1¼ ft. diameter, or else a huge main of that equivalent. In connection with a scheme of compressed air in Birmingham some years ago, where steel-riveted pipes were laid, 45 per cent. of the air escaped by leakage under a pressure of 5 atmospheres. It would be interesting to know what was going to happen as the result of the saturation of the soil with gas leaking on a corresponding scale. He also saw technical difficulties in riveting the pipes with the amount of space allowed by Mr. Smith. He thought the nuisance attaching to the sub stations was not to be neglected, and they had to consider the widely varying requirements that would be made on sub-stations, those in the central situations being the very ones which would have to be on the larger scale. The electric sub-stations were undoubtedly much better, and according to calculations which he had made the final costs were 0·39d. for the electric, and 0·42d. for the gas.

Mr. Housman said that one point which was seldom properly reckoned with in large schemes of this sort was the possibility of economical production of electricity by large works on their own account. For example, in a works with a total plant of 800 KW, having a load factor during the day of about 40 per cent., and a total load factor of between 15 and 20 per cent., the total works cost came out at about 0·45d. per unit. The cost during one day alone was only about 0·34d. That was without calculating interest and depreciation. As to the leakage from the distributing pipes which had been referred to, he understood it was due to the employment of lead for making the joints in the pipes. Owing to the heat of the compressed air, the pipes shrunk away at the joints.

Mr. Bell (of the British Westinghouse Co), dealing with the coal consumption, said at Walthamstow, where they had a Dowson producer, the consumption compared very favourably with other

stations in the same neighbourhood, and of similar output. At Walthamstow they were burning anthracite coal for which they had to pay a high price. He did not think that in the figure ·0624d. Mr. Smith had under-estimated the actual results of such a big plant as this. As to running in parallel, of course very little had been done in that direction. At the only station of which he could speak, the arrangement did not operate particularly well. Still he had seen some vertically-driven steam plants which had run equally badly. It depended very much, he thought, on the man who was running the alternators.

Mr. Groves said Mr. Smith had provided for the duplication of his cables but not of his pipe lines. It was an open question whether the pipe line should not be duplicated to put it on all-fours with a high pressure cable. The pipe line might break down owing to subsidence or earthquake, and it would not be safe to have only one line. Of course, if a fault occurred in a high-tension cable, it generally rendered it entirely inoperative, whereas a leakage on a gas main would not have that effect; but a fault in a cable was not difficult to locate, while the location of a leakage in a badly damaged pipe line would be a very dangerous matter. Again, the same catastrophe that causes the breakage of one pipe line, would probably have a similar effect upon another pipe alongside it, therefore the question arose whether it would not be better to provide alternative routes for the duplicate pipes. The effect of a subsidence on a steel pipe might be very much more serious than its effect upon an electric cable.

Mr. Taylor said they knew how liable to leakage was an ordinary gas main; in this case the pressure would be a hundred times as great.

Mr. Jones (of Leamington) thought a sufficiently strong pipe could be put down at such a depth as to be practically firm. The large sub-station necessary in the centre of the town would simply take the place of a large steam generating station. He thought Mr. Smith had been rather optimistic in regard to the load factor he had taken. If the load factor was taken too high—and it would certainly be a good many years before it reached the figure given—then the costs per unit were vitiated. Even if such a scheme were carried out, it would be many years before electricity could be sold at 1d. per unit, except at a loss. It seemed to him that one or two large stations supplied from a pipe line, instead of so many as five, might be a more practicable and easy mode of electric distribution. He did not see why the gas should not be used for the whole of the heating of the city, and why the use of coal should not be absolutely prohibited, thus making the city absolutely smokeless.

Mr. Smith then replied on the debate. He said the figures quoted in connection with the city of Birmingham were introduced simply to give the paper a little local colour, and did not affect the main issue in the least. He assumed when he estimated the load that there would be a selling price of something under 1d. per unit; with that conceded he did not think the figure was unduly optimistic. With regard to the application of Mr. Humphrey's figures to the Smethwick coal, he might say that when he applied to the Birmingham Canal Co., he told them exactly what he wanted the coal for, and they told him it was perfectly possible to supply it as he had stated. But the question of fuel did not really affect the main issue whether gas transmission was cheaper than electrical transmission. Prof. Threlfall alleged that makers would guarantee almost anything on a gas engine, and that sometimes the results were not up to guarantee; but that was perfectly true of steam engines, too, from what he had seen of them. He maintained that if they could supply the unit at a low price, the load factor would probably come out a good deal higher than he had calculated. Details on which his reckoning of cost had been criticised were common to both schemes, and therefore the comparison remained the same. Mr. Taylor painted an awful picture of the enormities of the gas mains. He had got out the figures for the five stations in order to afford a comparison with the five electrical stations, but he thought that, if one big main were put down in communication with small branches, it would reduce the cost very much. He did not think there would be the trouble which Mr. Taylor apprehended from the inflexibility of the system. With regard to the question of leakage, Mr. Taylor must remember that the compressed air scheme was 10 to 12 years old; engineering had advanced since then, and it was possible to make far better joints now. There might be a little leakage, but he did not think it would be anything like 10 per cent. The joints of hydraulic mains were made to withstand very much greater pressure than that proposed in the paper, and it was pedantic to assert that it would be impossible to make a proper joint for a gas main which would be absolutely tight. At the present moment it had been decided to transmit coal gas at five atmospheres for long distances, it being found to be more economical to do so than to generate separately in small towns. That economy would hold to a greater degree where ammonia recovery was possible. As for the gigantic size and inflexibility of the pipe lines, the supply of London with coal-gas meant mains ever so much bigger than the ones he had proposed. These London mains were not duplicated (to his knowledge), and they did not cause constant opening up and relaying of the streets. He did not quite see how duplicating the main would remedy the evils caused by earthquakes! The subsidence of the ground in the City area would equally damage water and the present gas mains, but he had never heard of it yet happening. There was no denying the fact that the gas engine sub-stations would be a great nuisance, but so were many of the electrical works now running He had not included the probability of there being a large demand for heating, because although he was aware that this would bring the load factor of the gas main up to 40 per cent., his critics would tell him that his figures were visionary. If the gas main were used for gas engine sub-stations, the greater glory of a smoke-freed city would follow. He wished that the figures had been attacked more, and opinions offered as to whether any steam station could compete with either of the schemes.

A hearty vote of thanks was accorded to Mr. Smith for his paper.

A NEW METHOD OF DETECTING ELECTRICAL OSCILLATIONS.

By J. A. EWING, LL.D., F.R.S., and L. H. WALTER, M.A.

(*Abstract of Paper read before the Royal Society, February 11th*, 1904.

The magnetic detector of Rutherford,* though now well known, appears to have created little interest until attention was directed to the subject by Marconi's adaptation of the method to his telephonic detector. Marconi's apparatus employs the change of hysteresis which is produced in iron by the influence of electric oscillations, when these are caused to pass through a coil surrounding the iron, the change being made manifest by means of a telephone. In his view, the electric oscillations act by reducing the hysteresis. †

It occurred to us to exhibit the alteration in hysteresis by applying the principle which is used in an instrument invented some years ago by one of us for the mechanical measurement of hysteresis. ‡

With this expectation, an experimental apparatus was arranged.

The first experiments resulted in a very small deflection from the position due to normal hysteresis, indicating, as was expected, a decrease of hysteresis when the oscillations arrived.

Various other forms were also tried with indifferent results, when it occurred to us that there would be advantages in passing the oscillations through the magnetic material itself, making it of magnetic wire. On passing oscillations through this winding, a remarkable and unexpected result was obtained. The change of deflection was much more marked than in the former experiments, and was in the opposite sense, indicating an increase of hysteresis while oscillations were present.

Owing to these encouraging results, it was decided to continue the experiments in this direction, abandoning the older form, in which a decrease of hysteresis was dealt with.

It was soon noticed that a non-inductive winding gave by far the best results.

In the instrument an electro-magnet is made to revolve by an electro-motor, the best speed being about five to eight revolutions per second. A structure is built up, external to the magnet, to support the vessel containing the pivoted bobbin and its centring arrangements. The bobbin itself is made of bone, and is about 2 in. long. It is provided with a steel spindle at each end bearing in a jewel hole. The winding, which is, as far as possible, non-inductive, consists of about 500 turns of No. 46-gauge hard-drawn steel wire, insulated with silk. Readings are taken by means of a spot of light, as with speaking mirror galvanometers, but a siphon-recording attachment has been fitted, and any form of contact for working a relay could be employed.

The detector gives quantitative readings, and a variable shunt is provided, by which the deflection can be regulated.

For the purpose of wireless telegraphy, the instrument has the advantage of giving metrical effects. The benefit of this in facilitating tuning, and in other respects, need not be insisted upon.

From the physical point of view, the augmentation of hysteresis is interesting and unlooked for. It is probably to be ascribed to this, that the oscillatory circular magnetisation facilitates the longitudinal magnetising process, enabling the steel to take up a much larger magnetisation at each reversal than it would otherwise take, and thus indirectly augmenting the hysteresis to such an extent that the direct influence of the oscillations in reducing it is overpowered. The net result appears to be dependent on two antagonistic influences, and, in fine steel wire, under the conditions of the experiments, the influence making for increased hysteresis, as a result of the increased range of magnetic induction, is much the more powerful.

THE COMPARATIVE BEHAVIOUR OF FLOATING AND BOOSTER-CONTROLLED BATTERIES ON FLUCTUATING LOADS.

The following is a summary of a paper recently read before the American Institute of Electrical Engineers, New York, by Lamar Lyndon. The author describes five methods of installing a battery at points distant from the generating station, in order to efficiently equalise the load on an electrically-operated railway:—

Case I.—Floating Battery in Station.

Consider the case of a fluctuating load. The minimum current is 200, maximum 1,000, and average 600 amperes. Such a load coming directly on the generating equipment must result in low efficiency and high fuel consumption per horse-power-hour; and will

* *Phil. Trans.*, *A*, Vol. 189, p. 1, 1897.
† *Roy. Soc. Proc.*, Vol. 70, pp. 341—344, 1902.
‡ *Journal Inst. Electrical Engineers*, Vol. 24, pp. 398—430, 1895.

require generators with large overload capacity and heavy engines to withstand the strains imposed. These represent the actual readings made on an operating electric railway; the load is carried over a two-mile feeder, and the minimum feeding voltage is to be 350. The summation curve of the system may be found from the

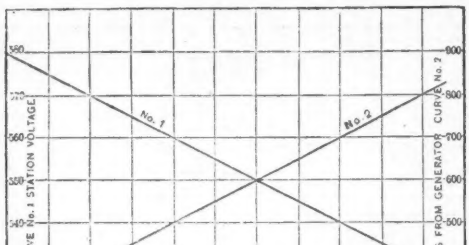

No. 1
No. 2
SUMMATION CURVE OR STATION CHARACTERISTIC=CURVE 1
GENERATOR AMPERES FOR VARIOUS LINE LOADS =CURVE 2
AMPERES TO LINE

Fig. 1.—Summation Curves, Theoretical Case.

characteristic curves of the generator and battery. Fig. 1 shows the summation curve for a theoretical case in which the characteristic curves of the generator and battery are straight lines. It gives the station voltage at any output to the external circuit; points on the summation curve were located, which gave line current as the abscissæ and station voltage as the ordinates. When the generator characteristic is a curve, we get a summation curve, as shown in fig. 2. This introduces complications. If the battery characteristic

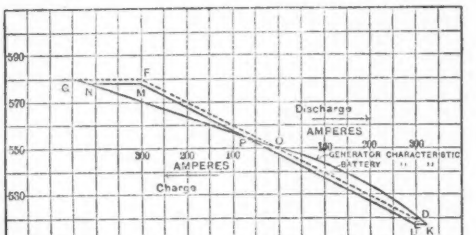


Fig. 2.—Battery and Generator Characteristics.

intersects that of the generator at the point of normal load—600 amperes—as indicated by the dotted line, the discharge on heavy loads will be greater than in the previous case, and at light loads the battery-charging current is less than in the previous case.

In any battery used for regulation, it is necessary that the input approximately equal the output, otherwise the state of battery charge is changed and the efficiency of the regulation decreased.

The conditions are obviously less advantageous in the actual case than in the theoretical case first discussed, and in

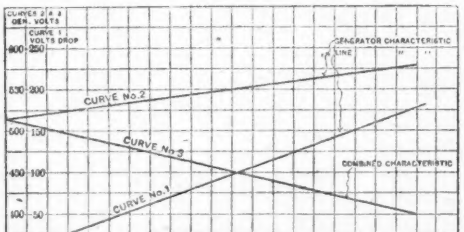


Fig. 3.—Characteristic Curves, Generator Over-compounded.

either case are worse than they would be with an over-compounded generator in the power station working without a battery. The mere reduction of mechanical strains and fuel-consumption are of little avail if fluctuations of supply cannot be met. In fig. 3 are plotted the characteristic of an over-compounded generator, the line characteristic with resistance 0·18 ohm, and a combination of these showing the total characteristic for the feeding-point.

Case II.—Floating Battery Out on the Line.

Consider now the case of a floating battery located at the feed point—two miles away from the station: Assume an over-compounded generator of 520 volts at no load, and 580 volts at full load of 800 amperes, and assume further that the battery will discharge 200 amperes at maximum load of 1,000 amperes, giving 800 amperes as the maximum transmitted over the line. If the minimum voltage allowable be 350 volts, the author calculates on 25 per cent. less copper than that required in the case of the compound-wound generator working alone.

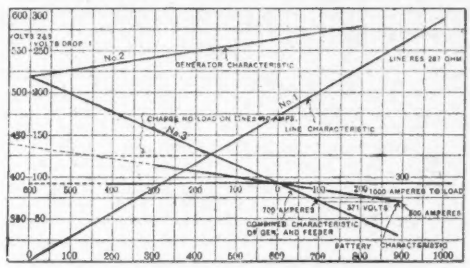


Fig. 4.—Characteristics, including 600-amp.-hour Battery.

Fig. 4 shows the generator characteristic, the line characteristic, the combined characteristic, and the characteristic of a 600 ampere-hour, 392-volt battery. This shows that when the maximum load of 1,000 amperes comes on the system the generator supplies 700 amperes, the battery 300, and the voltage is 371.

In fig. 5 are shown the summation curves of fig. 4, giving the voltage at the feeder-point for any current to the line. The only objectionable feature in this system is that the charging current at no load would be far in excess of the permissible rate.

The location of a floating battery at the feeding-point not only performs all the functions of equalisation, but the copper and size of generator are so much decreased that the saving will be greater than the cost of the battery, and the first cost of the system is less than in the case of a generator without the battery auxiliary. Furthermore, the battery voltage at the feeding point, on average load, is 392, as against 550 in the case of the battery located at the power station, and 28 per cent. less battery can be used in the first case. This also changes the inclination of the battery characteristic, the voltage increase or decrease in a given time being lower, the smaller the number of cells in series.

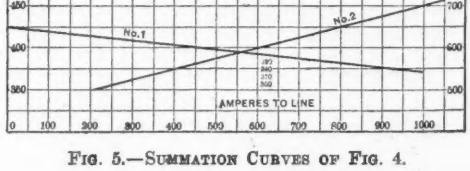


Fig. 5.—Summation Curves of Fig. 4.

The results of locating a battery on the line as compared with the use of a generator only are as follows:—More constant load on generator; copper cost reduced; voltage variation less, and with less copper minimum voltage is increased; full capacity of battery utilised.

In the operation of batteries in conjunction with booster auxiliaries, two types of regulating boosters are described:—One in which slight changes in line voltage cause changes in field excitation to produce charge or discharge; in the other the field excitation is varied by changes in external load.

With the first booster arrangement, at normal load, the battery is passive, the series field unexcited and booster voltage zero. With increasing load, the line voltage drops, and the battery in discharging energises the booster series field, inducing an E.M.F. to assist the battery E.M.F., the amount added equalling the drop due to discharge, and ranging directly in proportion to the latter. Conversely on a decreasing load, the line voltage rises, and the battery begins to charge; in this case the incoming charge reverses the field (compared with the last case), and the booster E.M.F. assists in charging the battery. The rise in both booster and battery voltages increases proportionately to the current, and the rise in battery E.M.F. is compensated for, the arrangement tending to maintain constant voltage and load.

Obviously the booster is operative only on systems having a falling characteristic with load increase—that is, with a shunt generator and battery.

In the second type of booster, at normal load the excitation of the series field, which is in the external circuit, is exactly equal to that of the shunt field. These, being oppositely wound, neutralise, and the booster voltage is zero. If the external load be increased, the series field overpowers the shunt field, and there results a booster E.M.F. proportional to the increase in external load and in a direction to cause the battery to discharge. Should the load decrease, the shunt field produces an E.M.F. in the booster armature to cause a charging current to flow into the battery. This booster can be used either with shunt or compound-wound machines.

(To be concluded.)

THROUGH BOOKING AND CONVEYANCE OF PASSENGERS, PARCELS AND MERCHANDISE ON TRAMWAYS AND LIGHT RAILWAYS.

By T. UPTON,
Goods Traffic Manager to the South Lancashire Tramways Co., &c.

With the linking up of the various tramway and light railway systems in different parts of the country, the question of through booking and conveyance of passengers, parcels and heavy merchandise becomes one of ever-increasing importance. The necessity for through bookings and conveyance has long since been recognised in respect to our railway systems, and is without doubt a self-evident proposition in respect to tramways and light railways.

Up to the present this question has only been dealt with in actual practice to a very limited extent, owing principally, no doubt, to the stand taken by authorities and others owning tramways and light railway undertakings, in not granting the necessary facilities, although physical connections already exist, or could be made at very slight cost, for its wide expansion over extensive areas, and in those instances where the through running of cars is in operation, it is impossible for passengers to book through from the starting to finishing point, although travelling in the same car the whole journey.

Moreover, it does not seem proper that passengers travelling on what are put forward as, and worked in connection as, through routes, should in all cases be compelled to change cars at the various boundaries—although, of course, admitting that all cars would not necessarily run through, others most certainly should do so—or to use more than one car on any one tramway system, forming part of a recognised through route on the direct line, neither should it be necessary for passengers to pay a distinct fare on each separate companies' section of their through journey, as is the case at the present time. There is no doubt this system of working is not by any means conducive to the building up of through traffic, as the public naturally resent so many changes and payments of fares, on what might be termed, at any rate, only a short journey of a few miles.

Still more unsatisfactory arrangements exist in regard to the conveyance of small parcels and heavy merchandise, and without doubt, while facilities for the carrying of such traffic is withheld, and the drawbacks of non-through booking and conveyance exist, tramways and light railways can never attain to their proper position as general carriers for the development of industries and inter-communication, but must retain their parochial distinctiveness, which appears to be the only aim and extent of usefulness in those instances of construction at less than the standard gauge of 4 ft. 8½ in. in districts where this standard generally obtains.

In the case of through bookings and conveyance of passengers, parcels, and heavy merchandise on railways, the amounts due to the respective companies are, generally speaking, proportioned out by the railway clearing house, but this does not apply to many cases, in which the amounts due from through rates are proportioned out between the companies themselves, by what is known as "private settlement."

It might not be out of place here to mention that the proportions are not worked out on the strict basis of mileage alone, for in numerous instances railway companies, on account of some special feature and heavy cost of construction of certain portions of their system, are allowed "extra" over and above what would be the case if strict mileage rates were charged. This extra charge is included in the rate, and such rate is increased by that amount above what it would otherwise be.

It would be idle to anticipate that tramway or light railway through bookings and conveyance, as in the case of railways with the interchange of numerous kinds and distinctive owners of rolling stock at specified junctions, mileage and demurrage charges on specially constructed and ordinary vehicles, besides a host of other matters, would attain to such proportions as to warrant the formation of a clearing scheme, with its attendant expenses for up-keep of offices, clerical staffs, checkers at junctions, inspectors and other cumbrous machinery, and without doubt "private settlements" between the systems concerned, could be made to meet all requirements, while the labour and cost incidental thereto would be very small indeed.

In the majority of cases, so far as passenger traffic is concerned, it could be done by the present staff, an alteration in the style of the books in operation being practically all that is necessary, together with fixed tables of proportions due to each section on each particular class of through ticket.

This system would apply in a limited degree to parcels and heavy mechandise, but seeing that terminal charges would have to be dealt with in both cases, and tonnage rates in respect to heavy merchandise, I will deal with these separately at a later stage.

The passenger traffic on the present tramway and light railway systems is almost, without exception, purely local, and little or nothing is done to develop through ordinary—to say nothing of through excursion—traffic, although it is certain that numbers of people would be glad to avail themselves of the tramways if they had the opportunity of so doing, notwithstanding that the speed at which tramcars travel is small as compared with the speed attained in railway transit.

This latter traffic is a source of much revenue to railway companies, and could be made so in many cases with a little energy and facilities for through bookings to tramway and light railway companies, running as they do from populous towns and manufacturing districts into suburban and rural spots such as the tripper and picnic parties would welcome, thereby being the means of opening up many places with subsequent increased ordinary traffic on the lines affected.

In the case of "through" booked passenger traffic, I would suggest that both single and return tickets be issued, the former available to travel only by the car on which issued, if going through to destination, but under any circumstances up to the point of interchange, whilst in regard to "return" tickets this rule should also be enforced on the outward journey, the return journey to be completed by any car on the same route or routes within a specified period from the date of issue, say, eight days.

In this connection, of course, arises at once the question as to how to know that the return journey is being completed within the time specified; but this difficulty could, I think, be very easily got over, provided, and as I would suggest, an alterable number and date punch were issued to conductors, in place of the present bell punch, and that ticket inspectors were also supplied with nippers carrying a letter and date, in order that it could be seen by whom and on what date the ticket was checked and cancelled, if considered necessary to have a double check.

At any rate, distinctive nippers for obvious reasons should be supplied to all inspectors at interchange boundaries, where they should examine and cancel all tickets of persons journeying through on the cars—persons joining the cars at a later stage would get their tickets cancelled a second time by the conductor on whose system they were travelling within the section on which they boarded the car. By these means I think it is clear that date punches which could only be altered by the ticket issuing department would reduce fraud to a minimum.

It does not follow that because through tickets are issued, the amount charged therefor should be less than the sum of the locals, but on return tickets it would without doubt be more conducive to business to make some small reduction, say, to a single fare and one-half of a single fare for the double journey, each company or system bearing its proportion of the loss of one-half of the through single fare.

In the case of excursion traffic, in which "return" tickets only are issued, the rates might be for the double journey the ordinary single fare plus one-third of the single fare, for quantities of 30 passengers and not exceeding 50; and for 50 to 100 passengers, an ordinary single fare plus one-quarter of such fare for the double journey, with, perhaps, a further slight reduction for larger parties, the difference between the full ordinary and excursion fares to be divided in proportion to the full ordinary fares between the systems concerned.

I think it advisable to collect as many tickets as possible, as, in making up the "settlement," it is, of course, a good check if the tickets have been collected, and are at hand; but, knowing that this could not always be relied

upon, and that it would be practically impossible for the conductors to collect all tickets on persons leaving the cars, it becomes a necessity to again copy the railway system, namely, that of the "issuing" company rendering an agreed upon form of statement at stated periods—say, monthly—to the other companies concerned, probably in the form of abstracts, showing daily the commencing and closing numbers of tickets issued, together with the total number of each kind or class of ticket issued, the amount received therefrom, and the amount due to each company or system.

On receipt of such statements, totalled and signed, the "receiving company" would check and sign their proportion, entering the amount on a voucher, which should be duly certified by the responsible persons of each undertaking, and settlement made in the usual way.

It would not necessarily entail the making out of separate monthly statements for each undertaking; they might be entered on one statement, to be passed forward by each section to the one next thereto, eventually being returned to the original issuing company, a concise summary of the totals of each class of ticket and the receipts therefrom, with proportion due, being issued to each undertaking participating in the receipts.

(*To be concluded.*)

POLYPHASE MACHINERY IN COLLIERIES.

It is a curious thing that while in every other branch of business some factory or works can be found that is thoroughly equipped with an electric power plant, yet it is doubtful whether in any colliery there is a complete installation. In the majority of pits, where electric power has been introduced, it has been confined chiefly to pumping plants, and to a lesser extent to part of the actual coal cutting, and to a portion of the haulage. The winding and ventilating plants are generally driven entirely by steam power; while the same means are adopted for a large portion of the haulage and other work which could be advantageously and economically performed with electrical power. The reason for this non-adoption of electrical power may be, in the case of the winding and ventilating, due to the fact that there is still a doubt on the part of many colliery managers as to the reliability of electrical power, and as a stoppage of either of these operations would be serious, it is considered advisable to continue using the older form of steam power. Or it may be that the winding and ventilating plants are usually placed in close proximity to the main bank of boilers, and, therefore, it is considered that there would be no economy effected by adopting electrical power.

Assuming that these reasons are valid, this does not explain why more use is not made of electrical power, both in the workings and at the head works, especially in those cases where the power is required some distance away from the main boilers. The main consideration that should decide the question of whether electrical power should be adopted or not is the question of return for the necessary outlay. If, by the expenditure of a given sum, the saving effected by the altered conditions of working repays the outlay, then electric power will be adopted, provided always that there are no counter-balancing considerations. If, on the other hand, the saving only amounts to a small percentage on the outlay, then it is not worth while going to the trouble of making the alteration, as the owners can obtain the same return for their capital in some other more convenient investment.

The fact that in so many collieries electrical transmission of power is being adopted for certain classes of work conclusively shows that in some circumstances electrical power does repay the outlay. We have seen that the chief use is made of this form of power for pumping purposes, and to a lesser extent for coal-cutting and for haulage. Now, all these are operations which are carried on some considerable distance away from the shaft bottom, and, failing the use of electricity, these operations would have to be performed through the agency of either compressed air or hydraulic power. In either case carefully-laid pipes are required, and it is well known that, however well the pipes may be laid in the first instance, sooner or later leakages will arise, with a corresponding diminution in the efficiency of the installation. The leaks can be remedied; but after the pipes are laid they get buried under the *débris*, and it is a difficult piece of work to definitely locate the point of leakage and lay bare the weak spot. The advantage of any class of electrical wiring is self-evident. The methods of running the wires differ according to the idea of the consulting engineer or the contractor, as the case may be. Sometimes ordinary vulcanised wires are employed, these being suspended from insulators affixed to the roofs. At other times an armoured cable is used, suspended in the same manner or laid along the side of the roadway. In other cases the cables of whatever class are laid in pipes buried in the ground. This last method approaches the practice adopted in the case of compressed air and hydraulic installations, but it has this advantage—that the pipes are not subjected to internal pressure, and therefore all joints are more likely to last; and even assuming that a leak does occur, it will not be the cause of any loss in efficiency, nor necessitate the digging up of the pipe. If, moreover, the cables are of the armoured class, the pipes are only necessary for mechanical protection, and while they should be well laid in the first place, a leaky joint will not cause any inconvenience.

The conditions which obtain in colliery work are entirely different from those which exist in any other class of works. It is most convenient to generate the power at the surface, but, especially for coal cutting and pumping operations, the power is required at long distances from the power station. This being the case, it is advisable to deal with currents at a high pressure. There is one objection to this in the case of direct current plant, and that is, that the various motors are generally in the charge of a non-technical man; even if a staff of electricians is retained, the members of this staff rarely actually run the machines. If, then, the motors are designed to work at a high voltage, there is always danger of some accident occurring to one of the operatives. Usual practice has decreed that the standard pressure for colliery work shall be about 500 volts for the generator, and, allowing for the drop in volts in transmission, 450 volts at the motor terminals. This, although a moderately high pressure, is not sufficiently high to ensure the most economical transmission in mines where the workings are two or three miles away from the power station.

If we consider the situation of the various machines which absorb power in a colliery, we shall find that many of them are on the surface, and therefore near the power house; others, those for haulage, are situated some at the shaft bottom, some down the roads, while the pumps and coal cutters are at the workings themselves, and therefore a considerable distance away from the power house. For the surface motors, and a large proportion if not all of the haulage motors, a pressure of 500 volts is ample. For the other motors the same pressure may be ample at the terminals of the machines for safe working, but this pressure is not large enough for economical transmission along long lengths of cable. With direct current machinery it is possible to raise the pressure for the actual transmission at the power house, and to reduce to 500 volts again at the workings by using a motor-generator in each instance; but this is a cumbrous method to adopt, and there are several objections to its being employed; one of the main objections being the cost of the apparatus, and another being that it would be necessary to retain a larger staff of electrical engineers to look after the plant.

With an alternating current installation, whether single or polyphase, the difficulty entirely disappears. All that is necessary is to pass the current through a step-up transformer at the power-house, and through a step-down transformer at the workings. In this apparatus there are no rotating or reciprocating parts, and no special attention is required. The efficiency of modern transformers is very high, so that the total loss can be reduced to a very small percentage. Another great advantage of this system is that any number of transformers may be used. For instance, while the whole of the current for the underground workings may be raised to several thousands of volts for transmission purposes, various circuits can be run, and a transformer put down to deal with the current that is required at any particular point. The expense of this system is not great, as the cost of a transformer is low—considerably less than the cost of a direct current motor-generator.

While this method of working is applicable to any alternating current system, it is advisable to adopt a polyphase system, as there is no difficulty experienced in starting the induction motors under load, and, with the exception of the difficulty of varying the speed, a polyphase system is as flexible in every way as a direct current system.

The use of polyphase installations is being adopted now to a very large extent in colliery work. Reference may be made to the electric transmission plant put down by Messrs. Ernest Scott and Mountain at Ty Tryst and Bedwelty Collieries for the Tredegar Iron and Coal Co., Ltd. Here the distance between the two collieries is about a mile, and the main plant is put down at the Ty Tryst Colliery. The system employed is three-phase alternating, and the current is generated at 500—550 volts, the periodicity being 40. The motors at Ty Tryst are supplied with current at a pressure of 500 volts; these motors are for driving the pumps and haulage gear. The cables are triple-core, and are run in pipes which are laid in the ground and covered over with rubbish. The current which is required at Bedwelty is passed through a three-phase transformer and raised to a pressure of 2,500 volts. The cables between the two collieries are carried overhead. A main switchboard is installed at Bedwelty, consisting of a high-tension and low-tension side. The incoming current is at a pressure of 2,000 volts, but is brought down by means of a transformer to 500 volts before reaching the low-tension main switch.

This installation gives us an example of what may be done economically in the transmission of power in colliery work, but there is the question as to whether it would not have been advisable to have carried the method further. At Ty Tryst the distance to some of the motors is a mile or more, and in many pits the distance to the furthest motors is considerably greater; the system of distribution is through distribution boards, and great economy in the expense of cables could have been made by using high pressure for all the transmission work. Again, at Bedwelty the pit shaft is 270 yards deep, and it would have caused a considerable saving to have carried the current for underground work at the high pressure—at least, to the bottom of the shaft.

We see that, owing to the ease with which the pressure of the current is raised and lowered, and the long distances that the current has to be conveyed in colliery work, there is a great economy effected by using a polyphase system, and it is the question of economy which will, in the first place, decide whether electrical power is used at all, and, in the second place, which should

decide the system to be adopted. There is still a more important consideration, and that is the question of safety. Here again the advantage is with the polyphase system. Direct current motors will spark at the brushes even under the best conditions, but with the variable loads which are thrown on the machines in hauling and coal-cutting work, it is impossible to hope to run sparklessly, especially when the air is laden with fine dust, as must be the case at the workings. Air-tight motors can be, and are, made, but they are expensive as compared to a more open type, and there is always the danger that they may be run not air-tight, which in a mine where there is a suspicion of gas is a most dangerous practice. With the induction motor there is no commutator, and if the squirrel cage type of rotor be adopted there are no rotating contact parts, so that there can be no danger from this cause. All danger of sparking at the distribution boards is eliminated if oil-filled switches only are used. There still remains the one danger of a spark occurring through the actual breaking of some conductor; this it is impossible to entirely eliminate, but by a system of careful inspection of the whole installation, preferably by independent experts, this danger is reduced to a minimum; and since the various boiler insurance companies have taken up the insurance and inspection of electrical machinery, employing a special staff of electrical engineers to deal with it, there is no difficulty in getting the necessary inspections made periodically.

From a study of the data which are available of electrical transmission, and hydraulic and compressed air transmission in collieries, it is evident that the most economical method is the electrical, and it is the question of the highest economy which will decide which system is adopted to the greatest extent. It is also evident that of the various electrical systems which may be adopted, the polyphase system will in many cases give the safest and most economical results.

PHYSICAL SOCIETY.

At the meeting held February 26th, 1904, Dr. R. T. Glazebrook, F.R.S., President, in the chair, "A New Dilatometer," exhibited by Mr. B. Bonniksen, was described by Mr. B. F. E. Keeling. The instrument was originally designed for measuring the expansion of balance-wheels of watches, and has latterly been applied to the determination of the coefficient of dilatation of specimens of materials, used in the form of wires about 1½ in. in length. The increase in length with change in temperature is magnified about 1,500 times by means of a chain of accurately mounted gear-wheels, the last one of which moves a pointer over a circularly graduated scale.

Dr. W. Watson read a paper on "A Quartz-thread Vertical Force Magnetograph." When the moment of inertia of the suspended system in a horizontal-force magnetograph is made very much smaller than that employed in the ordinary form, it is possible to detect variations in the earth's field of quick period. The design of a satisfactory form of instrument to record rapid variations of the vertical component presents very considerable difficulties. The instrument which the author has designed and constructed resembles, in principle, the quartz-thread gravity balance of Prof. Threlfall. In addition to the advantages derived from the suppression of the knife-edge, the instrument can be simply and accurately compensated for the effects of changes of temperature. The principle of the instrument is to have a magnet suspended on a horizontal quartz fibre kept stretched by means of a spring. The centre of gravity of the magnet and the torsion of the fibre are so adjusted that the axis of the magnet is horizontal. Any variation of the vertical force produces a rotation of the magnet about the fibre which can be suitably recorded by means of a mirror attached to the magnet. The temperature compensation is effected by weighting the magnet on the same side of the axis of the fibre as the south pole, so that the magnetic couple and the couple due to the torsion of the fibre act in the same direction. Hence, since an increase in temperature causes one of these couples to decrease and the other to increase, by suitably adjusting the weight, and therefore the magnitude of the torsion couple, complete compensation can be obtained. The instrument has been tested at the National Physical Laboratory, and it is proposed to set up one of the instruments in the new Magnetic Observatory.

Mr. C. V. Boys congratulated the author, and said the instrument showed that the properties of quartz-fibres were even more perfect than anything he himself had ever claimed for them.

Dr. J. A. Harker, when working with magnetographs of the Eschenhagen type, had found they became unstable when the sensitiveness was increased to about three times the Kew standard sensitiveness.

Mr. J. R. Ashworth sent a letter stating that the temperature compensation might be effected by using drawn steel wire magnets with an incremental temperature coefficient. Magnets can now be made to have, within limits, any assigned temperature coefficient (from negative, through zero, to positive).

Dr. Watson said he did not think that the magnets suggested by Mr. Ashworth would be of much advantage for vertical force magnetographs, as there would have to be a gravity-bob in all cases in order to adjust the centre of gravity of the moving system. They might, however, be of use in a horizontal force instrument. 1 cm. on the records corresponded to 8 γ, whereas 1 cm. on the Kew records represented 50 γ.

A paper by Mr G. W. Walker, "On Stresses in a Magnetostatic Field," was read by the Secretary.

Dr. W. Watson gave "Some Hints on the Preparation of Diagrams." He pointed out that many curves accompanying papers submitted to scientific societies have to be re-drawn on white Bristol board before they are suitable for reproduction by photographic processes. It is now possible to obtain blue-lined section paper such that the lines do not show in a photograph of a diagram drawn upon it. There are many advantages in using such paper. For instance, it practically dispenses with the use of scales and T-squares. When lettering diagrams a great saving of time and a uniformity of lettering can be effected by using india-rubber type. These can be purchased cheaply in different sizes and different founts. The larger types are sold as "easy sign markers," and are supplied with rods to ensure alignment and proper spacing, and also with rods by means of which the letters may be arranged upon a circular arc. A suitable ink for use with the type can be obtained by mixing Binfield's Persian black with glycerine. Using this ink for the lettering, and ordinary Indian ink for the line-work of a diagram drawn on blue-lined section paper, it is possible to slightly over-expose a photograph so that the section lines are invisible in lantern slides or prints prepared from it.

Mr. R. J. Sowter exhibited a portable electroscope of high insulation, adapted to show and measure the discharging effect of radio-active substances. As an electrophorus, Mr. Sowter has found a metal tea-tray supported on three glasses, together with a piece of brown paper warmed and brushed, satisfactory.

OUR LEGAL QUERY COLUMN.

[*Questions addressed to the Editors for insertion in this column should be written on one side of the paper. Free use of fictitious names, &c., may be made. Answers are furnished by a duly qualified lawyer, but the Editors cannot undertake to be responsible for the accuracy of the views which he may express.*]

"Worried" writes:—"There is a certain electrical engineer in this city, who, when his apprentices are a few minutes late, imposes a fine of threepence for every quarter of an hour, and says he is justified in doing so. I have heard from one or two friends that he cannot legally do this, and I thought that through the medium of your paper one of the readers of the Electrical Review could give me the exact position with regard to the law. I am not an apprentice but an articled pupil by agreement, and there are no such things as fines mentioned in the agreement.

"If the employer will not get a proper time check, I think it is a great injustice to teach his pupils to write false times of arrival. When he accidentally catches them one morning he then stops the money for an hour or two as a fine."

*** It is a little difficult to answer the above query without reference to the indentures of apprenticeship applicable to the case to which "Worried" refers. It is clear, however, that if an apprentice is regarded as a workman within the meaning of the Truck Acts, a deduction of a fine from his wages is illegal, unless the provisions of those Acts are observed. Sec. 1 of the Truck Act, 1896, provides that an employer shall not make any contract with any workman for any deduction from the sum contracted to be paid by the employer to the workman, or for any payment to the employer by the workman, for or in respect of any fine, unless (*a*) the terms of the contract are posted up in a notice; (*b*) the contract specifies the acts or omissions in respect of which the fine may be imposed; (*c*) the fine is in respect of some act or omission which causes, or is likely to cause, damage or loss to the employer, or interruption or hindrance to his business.

Further, the Section provides that the deduction must be made in pursuance of, or in accordance with, such a contract. It is clear from Sec. 2 of the Truck Amendment Act, 1887, that the provisions of these Acts apply to persons under the age of 21 years, and it is conceived that the contract of apprenticeship is not (for this purpose) distinguishable from any other contract of service. In the circumstances, "Worried" should ascertain whether the above-mentioned provisions of the Truck Acts are complied with by the employers. If not, the employers seem to have no right to impose the fines.

"Resident" writes:—"Will you kindly answer the following query as early as possible. The Board of Trade regulations (under the Lighting Acts of 1882 and 1888) state A. 38. "A suitable safety fuse or other automatic disconnector shall be inserted in each service line within a consumer's premises, as close as possible to the point of entry, and contained within a suitable locked or sealed receptacle of fireproof construction, except in cases where the service line is protected by fuses in a street box."

"In the case of small consumers occupying different rooms in the same premises, where feasible, I have used only one service line and fuse box. My construction of the regulation is that, where one service line supplies one or more consumers, one fuse box is all that is necessary to comply with the regulation. The question recently cropped up in this manner. A consumer, A, made an application for current. When interviewed he stated that eventually he intended sub-letting one room on his premises. Therefore, with the consent of A, the service line was brought in, and fuse box fixed, so that it would serve also for the said room if required. After some time the room was let to B, who made an application for current. A's wiring was done by contractor X, and B's by Y. Y asked if a separate fuse box would be fixed for B, and when answered in the negative he advised B not to sign the usual 'agreement form until the fuse box was fixed; contending that he could not give his usual guarantee for the work seeing that B would be

supplied from the same fuse box as A, who was wired by a rival contractor.

"I pointed out to Y that all he had to guarantee to B was his work, and that the onus of continuity of supply rested on the undertakers. Trusting that you will accept the apology of an old subscriber for trespassing on your kindness."

*** It is a little difficult to understand the exact nature of the question upon which "Resident" wants advice. He refers to the construction which he puts upon the Board of Trade regulation that affects his case, and it would seem to be the proper construction having regard to the proviso. Dealing with the regulation as a clause in a contract between the consumer and the undertaker, it seems clear that undertakers could not be compelled to provide a fuse-box upon a consumer's premises, if they already had one in the street box. As to the position of the contractor, it is impossible to see why he should be afraid to give a guarantee. The question is between the consumers and the undertakers, and the undertakers must be taken to know that there are fuses in their street boxes. In the circumstances, it seems that the advice given was quite correct. Generally, however, it may be doubted whether it is a sound plan to have a single fuse box for two or more customers, as a short-circuit by one consumer would involve the others in total darkness.

"Torfrida" writes:—"Would you kindly inform me through your paper if it is within the power of the Corporation of Ayr to charge the consumer for energy he has not used; that is to say, suppose my account for my house comes to, say, 15s. per year, can the Corporation charge me 20s. as per their bye-law, which says: 'A minimum charge of £1 per annum will be made for any quantity of current consumed, the cost of which is not equal to, or does not exceed, that sum.' Does the provisional order granted to this Corporation give them power to put this bye-law of theirs into force?

"I should also be pleased to know where I could see this provisional order, or where I could get a copy of it, as the consumers of electrical energy were going to oppose this Corporation in these charges."

*** It is impossible to give a satisfactory answer to the above query unless one has access to the provisional order in question. If that order follows the form provided by the Electric Lighting (Clauses) Act, 1899, there does not seem to be anything to prevent the undertakers making a minimum charge.

As to the second part of the query, the Corporation are bound to produce their provisional order to the consumer if he wants to refer to it. He should apply at their offices.

NEW PATENTS APPLIED FOR, 1904.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, to whom all inquiries should be addressed.

4,357. "Improvements in electrical transformers." J. S. Peck. (Date applied for under Patents Act 1901, February 28th, 1903, being date of application in United States.) February 22nd. (Complete.)

4,359. "A new or improved arrangement for insulating separately tanks or vessels containing acids or liquids electrically excited and in circulation." E. Kardos. February 22nd.

4,372. "Improvements in and relating to the electrolytic manufacture of chlorates and perchlorates." P. Corbin. (Date applied for under Patents Act, 1901, December 31st, 1903, being date of application in France.) February 22nd. (Complete.)

4,376. "Improvements in electricity meters." J. M. Tourtel and The Tourtel Manufacturing Co., Ltd. February 22nd.

4,378. "Improvements in electrical switches." W. S. Mappin and G. S. Mappin. February 22nd.

4,395. "Improvements in gripping appliances suitable for screwing lamp-shade clamp rings on and off electric incandescent lampholders." R. F. Ferguson. February 22nd.

4,396. "Improvements in means or apparatus for controlling incandescent electric lamps." R. F. Ferguson. February 22nd.

4,443. "Improvements in collectors or trolley-arm heads for electric traction systems." H. Peace. February 23rd.

4,448. "Thermal cut-out for electric circuits." W. Fairweather. (American Electric Telephone Co., United States.) February 23rd. (Complete.)

4,449. "Thermal cut-out for electric circuits." W. Fairweather. (American Electric Telephone Co., United States.) February 23rd. (Complete.)

4,450. "Thermal cut-out for electric circuits." W. Fairweather. (American Electric Telephone Co., United States.) February 23rd. (Complete.)

4,451. "Improvements in and relating to electrical switches." G. Sperryn and W. H. Wood. February 23rd. (Complete.)

4,461. "Improvements in electric traction systems." E. F. Moy and P. H. Bastie. February 23rd.

4,472. "Improvements in and connected with audiphones, telephones and like instruments employed for the transmission of sound." H. G. Pape and E. J. Higgins. February 23rd. (Complete.)

4,473. "Improvements in and connected with audiphones, telephones and like instruments employed for the transmission of sound." H. G. Pape and E. J. Higgins. February 23rd. (Complete.)

4,487. "Improved process and apparatus for the manufacture of sulphate of copper and caustic alkalies by the electrolysis of alkaline chlorides." H. M. Granier. February 23rd. (Date applied for under Patents Act, 1901, April 6th, 1903, being date of application in France.) (Complete.)

4,507. "Improvements in electric controllers." A. C. Eastwood. February 23rd. (Complete.)

4,519. "Improvements in electric mercury vapour lamps." G. Bamberg. February 23rd.

4,579. "Improvements in electric arc lamps." S. B. Griffith and F. Biliotti. February 24th.

4,581. "Improved means applicable for use in mounting electro-type plates for printing purposes." E. Pitman. February 24th.

4,587. "Improved construction of electric switch." G. Smith. February 24th.

4,590. "An improved telephone annunciator or indicator switchboard. A. Eckstein and F. G. Bell. February 24th. (Complete.)

4,592. "Improvements in electro or other magnets." E. Shoults and S. Bridgwater. February 24th.

4,594. "New system of operation of make-and-break devices for electric circuits and apparatus therefor." F. Seary and J. Lenderyou. (February 24th.

4,609. "Improvements in indicators operated electrically from a distance." B. Becker. February 24th.

4,629. "An improved electric arc lamp." G. C. Shanester. February 25th.

4,646. "Improvements in or in connection with metallic circuit inter-communication telephones." M. W. F. Petmeky. February 25th.

4,660. "Improvements in electric contact breakers or tremblers for ignition coils." S. R. Cohen and B. R. Cohen. February 25th.

4,663. "Improved means for rupturing electric circuits." P. H. Thomas. February 25th. (Complete.)

4,676. "Improvements in or connected with insulators for the conductors of electric railways." F. D. Ward and H. C. Furniss. February 25th.

4,704. "Improvements in or relating to current-collecting skates for conduit electric traction systems." M. O. Spicknall. February 25th.

4,721. "An improved auto-condensation plate for use with electric currents of high potential and frequency for therapeutic purposes." E. Brown. February 26th.

4,731. "Improvements in or applicable to pendant incandescent electric lamps." G. H. Scholes. February 26th.

4,769. "Improvements in alternating current motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 26th.

4,770. "Improvements in automatic regulating current motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 26th.

4,771. "Improvements in alternating current motor control." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 26th.

4,772. "Improvements in controlling alternating current motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 26th.

4,773. "Improvements in controlling alternating current motors." The British Thomson-Houston Co., Ltd. (The General Electric Co., United States.) February 26th.

4,785. "Improvements relating to reproduction of sound by means of phonographic and electrical apparatus." H. F. L. Hantz. February 26th.

4,866. "Improvements in electric transformer furnaces." O. Frick. February 17th. (Complete.)

4,869. "Improvements in wireless telegraphy." G. Marconi. (Date applied for under Patents Act, 1901, October 13th, 1903, being date of application in United States.) February 27th. (Complete.)

4,874. "Improvements relating to trolley poles for cars electrically propelled on the overhead system." W. H. Kilbourn and A. D. Flower. February 27th.

PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, price, post free, 9d. (in stamps).

1902.

Electric Post, being a method of and means for the Collection, Transmission and Distribution of Letters, Parcels and the like. C. R. T. Pisciceli. 18,637. August 25th.

Telephone Exchange Mechanism. R. Haddan. (Communicated.) 18,747. August 26th.

Electricity Meters. S. Z. de Ferranti and W. Hamilton. 18,766. August 26th.

Electric Motor Control Systems. British Thomson-Houston Co., Ltd. (W. O. Mundy.) 18,817.

Electric Transformers. British Thomson-Houston Co., Ltd. (W. S. Moody.) 18,818.

Electric Switches and Cut-outs. British Thomson-Houston Co., Ltd. (C. C. Badeau.) 18,819. August 27th.

Electric Motor Control Systems. British Thomson-Houston Co., Ltd. (F. E. Case.) 18,821. August 27th.

Variable Speed Driving Mechanism for Electric Motors. H. H. Lake. (Communicated.) 18,924. August 28th.

Rheostats for Starting Electric Motors. H. H. Lake. 18,925. August 28th.

Joint for Electrical Fittings. R. W. Braham. 19,079. August 30th.

Breaking Electric Arcs. H. Hasling and Callender's Cable and Construction Co., Ltd. 19,097.

Devices for Operating Trolley Arms. E. Limange. 19,172. September 1st.

Electric Transmission and Controlling Gear. J. Johnston and A. E. Dobbs. 19,283. September 2nd.

Electric Burglar Alarms. H. J. Haddan. 19,291. September 2nd.

Applying Bituminous or Similar Composition to Conduits for Electric Cables. W. Oates. 19,305. September 3rd.

Electric Cable Conductors. W. E. Hitch. 19,866. September 4th.

Electrodes for Electrolytic Purposes. J. Hargreaves. 19,368. September 4th.

Electrical Switches. H. H. Lake. (General Electric Co., Ltd.) 19,564. September 6th.

Insulating Bushings. H. H. Lake. (General Electric Co., Ltd.) 19,565. September 6th.

Electric Switch Regulators. H. H. Lake. (General Electric Co., Ltd.) 19,566. September 6th.

Trolley Wheels for Electric Traction. H. H. Lake. (General Electric Co., Ltd.) 19,567. September 6th.

Cooling of Electric Motors. H. H. Lake. (General Electric Co., Ltd.) 19,568. September 6th.

Electrical Distribution. H. H. Lake. (General Electric Co., Ltd.) 19,571. September 6th.

Contact Shoes for Electric Railways. H. H. Lake. (General Electric Co., Ltd.) 19,573. September 6th.

Detection of Short-Circuits in Electric Batteries. H. Beckmann. 19,579. September 6th.

Alternating Current Meters. A. May. 19,655. September 8th.

Production of Caustic Soda and Sodium Hypochlorate by Electrolysis. F. Ferrand. 19,774. September 10th.

Electrical Contrivance for Communicating with Passing Trains. E. W. Glover. (Communicated.) 19,891. September 11th.

Secondary Battery Elements. L. Fielder and G. Puchmuller. 19,999. September 12th.

Supporting Arc Lamps. A. J. Boult. (Communicated.) 20,008. September 12th.

Trolley Wire Holders. P. Redford. 20,024. September 13th.

Arc Lamps. L. Wirtz and T. H. Adams. 20,074. September 13th.